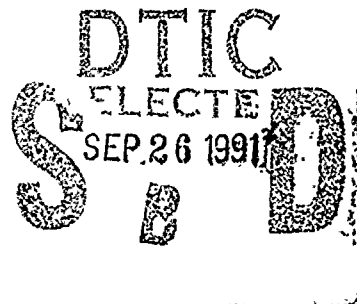PL-TR-91-2140 **AD-A241 583**

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COMBINED RELEASE AND RADIATION EFFECTS SATELLITE
TIME HISTORY DATA BASE

Dennis E. Delorey

INSTITUTE FOR SPACE RESEARCH
BOSTON COLLEGE
Newton Massachusetts 02159

31 May 1991

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Scientific Report No. 1

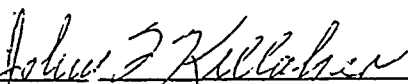Approved for public release; distribution unlimited

Phillips Laboratory
Air Force Systems Command
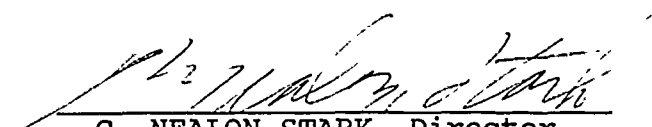Hanscom AFB Massachusetts 01731-5000

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91 9 24 020

"This technical report has been reviewed and is approved for publication"

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17.	COSATI CODES		18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	CRRES PROGRAM CALIBRATION FILES EPHEMERIS FILES
			TIME HISTORY DATA BASE ATTITUDE DATA FILE STRUCTURE
			SPACECRAFT SENSORS SENSOR DATA

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The design, development and implementation factors necessary for the generation of a Time History Data Base (THDB) for the Combined Release and Radiation Effects Satellite (CRRES) mission are described. The CRRES THDB consists of structured, time ordered files of spacecraft sensor data, calibration files, attitude fit, coefficient files and ephemeris files all produced on an orbit-by-orbit and instrument-by-instrument basis. This report describes the make up of these files and their place in the data base. A brief description of the available parameters is presented.

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1.0   INTRODUCTION

The Institute for Space Research at Boston College has been tasked by the Phillips Laboratory/Geophysics Directorate (PL/GD) under contract F19-628-90-K0028 to design, develop, and implement the generation of the Time History Data Base (THDB) for the Combined Release and Radiation Effects Satellite (CRRES) mission.

The spacecraft was successfully launched from Cape Canaveral, Florida on 25 July 1990 at approximately 15:21 EDT.

The CRRES THDB consists of structured, time ordered files of spacecraft sensor data, calibration files, attitude fit coefficient files, and ephemeris files.

THDB files are produced on an instrument by instrument and orbit by orbit basis. An orbit is defined as a spacecraft revolution starting at perigee and ending at the following perigee.

The THDB files, except for the calibration and attitude fit coefficient files, are generated in integer form and consist of time tagged structured data.

The sensor data files are generated in counts (uncalibrated form). Separate files containing the calibrations necessary for the conversion of the counts data to science units will be maintained. These calibration files are in ASCII form and will be updated as often as necessary throughout the mission.

The use of integer storage for the sensor data files provides the flexibility which allows users to have ready access to the data from various computers (e.g. CYBER/NOSVE, VAX, or PC). All parameters are stored in INT*4, INT*2, or INT*1 form.

THDB files containing sensor data consist of a header record followed by a series of data records. Each file is of fixed record length structure.

In general, the sensor data is stored at the full data rate. Data records consist of a UT time tag and data grouped into logical structures (e.g. for particle sensors, the logical grouping would consist of the data for a full spectra).

For some sensors, the algorithms necessary to convert the telemetry data to science units are extremely complex. For these sensors, pre-processed files are generated which are used as input to analysis routines which produce the science unit output. These files do not strictly fit the concept of the THDB, but are nevertheless referred to as THDB structures. In general, these files are useful only in conjunction with the analysis software routines. Pre-processed files are clearly identified in this document.

A brief description of the parameters available from each THDB file, along with the THDB file format, is contained in the succeeding sections.

Calibration formulas, as well as calibration file structures presented in this report, should be considered to be preliminary and, hence, subject to change.

2.0   AFGL 701-2   SPACE RADIATION DOSIMETER
PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL
Dr. Susan Gussenhoven / PL
Fred Hanser / Panametrics
Bronek Dichter / Panametrics

2.1   THDB DERIVABLE PARAMETERS

The THDB for this sensor is a pre-processed file consisting of compressed counts for all
readouts. The full data set is restructured into logical groupings and stored in byte form.
One data base record is generated with data collected over 4 masterframes. The data for the
4 domes is structured to begin with dome 1 and is followed by the other domes, in
sequence. The UT time tag is adjusted to coincide with the minor frame containing the
dome 1 data.

Data for this sensor is acquired for all spacecraft telemetry modes.

The following parameters, available at 4.096 second intervals, are derivable from the
analysis routine which uses the pre-processed file as input:

Accumulated HILET dose
Accumulated LOLET dose
Star flux
Integral HILET flux counts
Integral LOLET flux counts
HILET dose rate
LOLET dose rate

2.2   THDB DATA RECORD STRUCTURE

The THDB files for the AFGL 701-2 consist of a header record followed by a series of data
records. The header record is in 32 bit positive integer form. There is data from four
masterframes in each of the data records (16.384 seconds). The order of the data for the
four domes will be dome 1, dome 2, dome 3, and dome 4.

HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (7012)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-30	Vacant (Zero fill)

2

DATA RECORDS:

Word Number	Description

1   UT (milliseconds)

2   Bit 27 = Dome Dropout flag (0=no dropout, 1=dropout)
Bit 26 = Mode ID bit (I)
Bit 25 = Cal ID bit (M)
Bit 24 = Dome ID bit (D)
Bits 23-16:In mode A; PDOSE (bbEEEEMM) for dome 1
         In mode B; PDOSE mantissa and Proton ripple
         counter (bbMMRRRR) for dome 1
Bits 15-8:In mode A; EDOSE (bbEEEEMM) for dome 1
         In mode B; EDOSE mantissa and Electron
         ripple counter (bbMMRRRR) for dome 1
Bits 7-0:Star flux (bbbSSSSS) for dome 1

3   Bits 31-24:Proton Flux (EEEMMMMM) for dome 1
Bits 23-16:Electron Flux (EEEEMMMM) for dome 1
Bit 11 = Dome Dropout flag (0=no dropout, 1=dropout)
Bit 10 = Mode ID bit (I)
Bit 9 = Cal ID bit (M)
Bit 8 = Dome ID bit (D)
Bits 7-0:In mode A; PDOSE (bbEEEEMM) for dome 2
         In mode B; PDOSE mantissa and Proton ripple
         counter (bbMMRRRR) for dome 2

4   Bits 31-24:In mode A; EDOSE (bbEEEEMM) for dome 2
         In mode B; EDOSE mantissa and Electron
         ripple counter (bbMMRRRR) for dome 2
Bits 23-16:Star flux (bbbSSSSS) for dome 2
Bits15-8:Proton Flux (EEEMMMMM) for dome 2
Bits 7-0:Electron Flux (EEEEMMMM) for dome 2

5   Bit 27 = Dome Dropout flag (0=no dropout, 1=dropout)
Bit 26 = Mode ID bit (I)
Bit 25 = Cal ID bit (M)
Bit 24 = Dome ID bit (D)
Bits 23-16:In mode A; PDOSE (bbEEEEMM) for dome 3
         In mode B; PDOSE mantissa and Proton ripple
         counter (bbMMRRRR) for dome 3
Bits 15-8:In mode A; EDOSE (bbEEEEMM) for dome 3
         In mode B; EDOSE mantissa and Electron
         ripple counter (bbMMRRRR) for dome 3
Bits 7-0:Star flux (bbbSSSSS) for dome 3

6   Bits 31-24:Proton Flux (EEEMMMMM) for dome 3
Bits 23-16:Electron Flux (EEEEMMMM) for dome 3
Bit 11 = Dome Dropout flag (0=no dropout, 1=dropout)
Bit 10 = Mode ID bit (I)
Bit 9 = Cal ID bit (M)
Bit 8 = Dome ID bit (D)
Bits 7-0:In mode A; PDOSE (bbEEEEMM) for dome 4
         In mode B; PDOSE mantissa and Proton ripple
         counter (bbMMRRRR) for dome 4

7	Bits 31-24:In mode A; EDOSE (bbEEEEMM) for dome 4
	In mode B; EDOSE mantissa and Electron
	ripple counter (bbMMRRRR) for dome 4
	Bits 23-16:Star flux (bbbSSSSS) for dome 4
	Bits 15-8:Proton Flux (EEEMMMMM) for dome 4
	Bits 7-0:Electron Flux (EEEEMMMM) for dome 4
8-14	Repeat order of words 1-7 for next masterframe
15-21	Repeat order of words 1-7 for next masterframe
22-28	Repeat order of words 1-7 for next masterframe
29-30	Vacant

Note:

1.   In areas of telemetry dropout, dummy fill (1 fill) will be inserted and the telemetry dropout flag set to 1.

3.0   AFGL 701-3 METAL OXIDE SEMICONDUCTOR (MOS) DOSIMETER

PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL
Bill Stapor / NRL

3.1   THDB DERIVABLE PARAMETERS

The THDB has one record per major frame consisting of the analog voltages (in millivolts) for the four PMOS transistors; PCM counts for the temperature and reference voltage monitors; and the bilevels for expose/read and on/off. The THDB file is generated for only those periods when the instrument is in READ mode. During READ mode periods, there is one record generated per major frame (4.096 sec).

Dose is computed from the THDB information by means of an equation of the form:

$$\text{Dose}(i) = \{[a(i) + b(i) * V(i)] - c(i)\} / d(i).$$

where $V(i)$ are the 4 analog voltages for the four transistors and a, b, c, and d are transistor dependent constants.

Data for this sensor is acquired for all spacecraft telemetry modes.

3.2   THDB DATA RECORD STRUCTURE

The AFGL 701-3 THDB files consist of a header record followed by a series of data records. The header record is in 32 bit positive integer form. There is one data record per major frame (4.096 sec) in only those time intervals where the instrument is in READ mode.

HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (7013)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)

DATA RECORDS:

Word Number	Description
1	UT (milliseconds)
2-5	Telemetry volts (millivolts) for the 4 PMOS transistor (Telemetry words A196, A197, A198, A199)
6	Four bytes. The most significant byte contains telemetry counts for temperature (A200); next byte contains telemetry counts for reference voltage monitor (A201); next byte contains expose/read discrete in its LSB; the least significant byte contains the power on/off discrete in the LSB.

3.3 CALIBRATION FILE RECORD STRUCTURE

The AFGL 701-3 calibration file will consist of ASCII data. The file will contain a series of header records, and calibration factors necessary to convert the telemetry voltage values for the 4 analogs to dose. There will be one information word per record. In addition, a series of comment records (optional) will be allowed for.

HEADER RECORDS:

Rec.

1	Number of calibration files
2	Number of Header records which follow (10) (I)
3	Experiment Number (AFGL 7013) (CHAR*20)
4	Calibration version number (I)
5	Valid start date for calibration. (e.g. 89105) (I)
6	Valid end date for calibration (I)
7	Number of record types in calibration file (5) (I)
8	Number of Comment records (I)
9	Number of 'a' constant records (I)
10	Number of 'b' constant records (I)
11	Number of 'c' constant records (I)
12	Number of 'd' constant records (I)

COMMENT RECORDS (all records CHAR*80):

Rec.

1-N   Comment records

RECORDS FOR THE 'a' CONSTANTS (all words REAL):

Rec.

1   a1
2   a2
3   a3
4   a4

RECORDS FOR THE 'b' CONSTANTS(all words REAL):

Rec.

1   b1
2   b2
3   b3
4   b4

RECORDS FOR THE 'c' CONSTANTS (all words REAL):

Rec.

1   c1
2   c2
3   c3
4   c4

RECORDS FOR THE 'd' CONSTANTS (all words REAL):

Rec.

1   d1
2   d2
3   d3
4   d4

4.0   AFGL 701-4 HIGH ENERGY ELECTRON FLUXMETER (HEEF)
PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL
Don Brautigam / PL
Fred Hanser / Panametrics
Bronek Dichter / Panametrics

4.1   THDB DERIVABLE PARAMETERS

The THDB has the compressed counts from 12 integral flux and singles channels, the 10 differential flux channels (LL, L1, L2, ..., L9) in the range of 1-10MeV and a packed word consisting of three discretes and the PCM counts for the HV monitor. For the differential flux data, decompression of the counts is not required. The differential flux, integral flux, and singles data are stored in 16 bit words. One THDB record is generated for every 4 minor telemetry frames.

The decompression algorithm used for the integral flux and singles channels is as follows:

$$TRUE\ COUNTS = M * 2^E$$

where M is the mantissa and E is the exponent.

The data word length for the singles channels and integral flux values varies from 11 to 13 bits.

Conversion of decompressed counts to both integral flux and differential flux is performed by means of one multiplicative constant per channel.

The time tag associated with each THDB record is the time at which the data was placed in the telemetry stream. The data was accumulated during the previous 4 minor frame intervals (nominally 512MS).

Data for this sensor is acquired for all spacecraft telemetry modes.

4.2   THDB DATA RECORD STRUCTURE

The THDB file consists of a 16 word (32 bit words) header record followed by a series of data records.

There is one data record per 0.512 secs (4 TLM frames). The compressed counts for the differential and integral channels as well as the singles channels are stored in 16 bit words.

HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (value is 7014)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)

7

6	End Time of orbit (UT in milliseconds)
7-16	Vacant (Zero fill)

DATA RECORDS:

Word Number	Description
1	UT (milliseconds)
2-6	Compressed counts for the 10 pt differential electron spectrum. The word order is L9, L8,...,L1, LL.
7-12	Compressed counts for the singles channels and the integral channel. The word order is S2F, S1F, W1F, W2F, S2B, S1B, W1B, W2B, L10S, L10C, BGO, and LS.
13	Bilevels MB1, MB2, MB3 and 8 bit HVM counts stored in the 11 LSBS of this word.
14	Dropout flag.
15-16	Vacant

Notes:

1. Dummy fill (1's fill) will be used for dropout within a spectra.

2. The dropout flag will have the value '1' if dropout occurred anywhere within the .512 second period.

4.3 CALIBRATION FILE RECORD STRUCTURE

The AFGL 701-4 calibration file will consist of ASCII data. The file will contain a series of header records, comment records, energy value records associated with the differential channels, geometric factor records for the differential channels, and channel dependent constant records for computation of integral flux. There will be one information word per record.

HEADER RECORDS:

Rec.

1	Number of calibration files
2	Number of Header records which follow (9) (I)
3	Experiment Number (AFGL 7014) (CHAR*20)
4	Calibration version number (I)
5	Valid start date for calibration. (e.g. 89105) (I)
6	Valid end date for calibration (I)
7	Number of record types in calibration file (4) (I)
8	Number of Comment records (I)
9	Number of Energy Channel records (I)
10	Number of Geometric Factor records for differential flux(I)
11	Number of Channel Constant records for integral flux(I)

COMMENT RECORDS (all records CHAR*80):

Rec.

1-N   Comment records

ENERGY CHANNEL RECORDS (all words REAL):

Rec.

1	L9
2	L8
3	L7
.	.
.	.
8	L2
9	L1
10	LL

GEOMETRIC FACTOR RECORDS (all words REAL):

Rec.

1	GF for L9
2	GF for L8
3	GF for L7
.	.
.	.
8	GF for L2
9	GF for L1
10	GF for LL

CHANNEL DEPENDENT CONSTANT RECORDS FOR FLUX (all words REAL):

Rec.

1	Constant for S2F (background)
2	Constant for SF1
.	.
.	.
.	.
10	Constant for L10C
11	BGO
12	LS

5.0 AFGL 701-5A MEDIUM ENERGY ELECTRON SPECTROMETER (MEES)

PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL
                                     Dr. Al Vampola / Aerospace

5.1 THDB DERIVABLE PARAMETERS

The THDB records contain compressed counts representing differential flux from 17 electron channels (0.1-1.7MeV) every 0.512 s. The time tag on the THDB records is the time at the start of the minor frame on which the data was placed in the telemetry stream. The spectra data was accumulated during the previous .512 seconds.

The decompression algorithm to convert compressed counts to true counts requires the extraction of the 3 MSBs and the 9 LSBs from the 12 bit word. The 3 MSBs represent the exponent (e) and the 9 LSBs represent the mantissa (m). The formula to convert the compressed counts to true counts is as follows:

$$\text{COUNTS} = m \ \ \text{if} \ e = 0,$$

and

$$\text{COUNTS} = [2 ** (e\text{-}1)] * [512 + m] \ \ \text{if} \ 0 < e < 8.$$

Conversion of the decompressed counts into differential number flux is accomplished by an equation of the form:

$$\text{Flux}(i) = [\text{Counts}(i) - \text{Counts}(16) \times K(i)] / \text{GEF}(i) / .512$$

where $i = 0, 17$,
Counts(16) represents background counts,
Counts(i) represents the counts for channel (i),
K(i) are channel dependent constants (approximately = 1),
and GEF(i) are the combined geometric and efficiency factors used to convert to flux.

Data for this sensor is acquired only during spacecraft GTO telemetry mode.

5.2 THDB DATA RECORD STRUCTURE

The THDB files for this sensor consist of a header record (in 32 bit integer form) followed by a series of data records.

THDB Data Records - Medium Energy Electrons data for 17 differential electron energy channels plus one background channel will be stored in 16 bit words (two 16 bit words per 32 bit word). The vacant/flag word at the end of each record will have the value 0 (for normal operations) or 1 (to indicate that a data gap will follow due to the spacecraft telemetry mode being changed to CSM or LAS mode).

Each record will have data accumulated over 4 telemetry frames (0.512 secs). Dropout words within a spectra will be noted by 1's fill. If dropout occurs over a full spectra, there will be no fill. The data will simply be missing.

HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (value is 70151)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-12	Vacant (Zero fill)

DATA RECORDS (32 bit words):

Word Number	Description
1	UT (milliseconds)
2	Compressed counts for E0 and E1
3	" " " E2 and E3
4	" " " E4 and E5
5	" " " E6 and E7
6	" " " E8 and E9
7	" " " E10 and E11
8	" " " E12 and E13
9	" " " E14 and E15
10	" " " E16 (background) and E17
11	Byte 3:vacant

Byte 2:Telemetry Dropout flag (Value = 1 if dropout in this frame, normal value is 0)

Byte 1:

Bit 7 = Sync indicator; 0=sync ok, 1=sync mismatch
Bit 6 = C (Calibration flag)
Bit 5 = K (Ram check status)
Bit 4 = N (Format mode)
Bit 3 = S (Sun Pulse bit)
Bit 2 = T (Contents of TM)
Bit 1 = W (Ram Reload)
Bit 0 = Telemetry flag. Normally 0; will be set to 1 if a data gap follows due to a switch to CSM or LASSII telemetry mode.

| 12 | Vacant |

5.3 CALIBRATION FILE RECORD STRUCTURE

The AFGL 701-5A calibration file will consist of ASCII data. The file will contain a series of header records, comment records, energy value records, geometric factor records, and channel dependent constant records. There will be one information word per record.

HEADER RECORDS:

Rec.

1	Number of calibration files
2	Number of Header records which follow (9) (I)
3	Experiment Number (AFGL 7015A) (CHAR*20)
4	Calibration version number (I)
5	Valid start date for calibration. (e.g. 89105) (I)
6	Valid end date for calibration (I)
7	Number of record types in calibration file (4) (I)
8	Number of Comment records (I)
9	Number of Energy Channel records (I)
10	Number of Geometric/Efficiency Factor records (I)
11	Number of Channel Constant records (I)

COMMENT RECORDS (all records CHAR*80):

Rec.

1-N   Comment records

ENERGY CHANNEL RECORDS (all words REAL):

Rec.

1	E0
2	E1
3	E2
.	.
.	.
.	.
16	E15
17	E16 (BACKGROUND)
18	E17

GEOMETRIC/EFFICIENCY FACTOR RECORDS (all words REAL):

Rec.

1	GEF0
2	GEF1
3	GEF2
.	.
.	.

```
16    GEF15
17    GEF16 (BACKGROUND)
18    GEF17
```

CHANNEL DEPENDENT CONSTANT RECORDS (all words REAL):

Rec.

```
 1    K0
 2    K1
 .    .
 .    .
 .    .
16    K15
17    K16 (BACKGROUND)
18    K17
```

6.0 AFGL 701-5B ELECTRON-PROTON ANGLE SPECTROMETER (EPAS)

PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL
                            Dr Alex Korth / Max Plank

6.1 THDB DERIVABLE PARAMETERS

The THDB has one record per four minor telemetry frames (.512 seconds) and contains the compressed counts (in byte form) from the two 14 point electron spectra (20-250 keV) and the associated detector numbers; the 12 point proton spectra (30keV-20MeV) and associated detector number; the 10 electron and 4 proton integral flux values; the proton coincidence and background counting rates; and selected discretes.

For the 8 bit compressed counts values, the 4 MSBs of the word represent the exponent (e) and the 4 LSBs represent the mantissa (m). The decompression algorithm is as follows:

$$COUNTS = m \text{ if } e = 0,$$

and

$$COUNTS = [2 ** (e-1)] * [16 + m] \text{ if } 0 < e < 16$$

A data record is written once every .512 seconds.

Each record contains counts (accumulated over .512 seconds) representing integral flux from the 10 electron detectors and 4 ion detectors. The time tag on each record marks the end of the .512 second accumulation interval. Each record also contains the counts for a 12 point energy spectrum from 1 ion detector. The timing for the differential ion data is identical to that of the integral ion and electron data. Counts for fourteen point energy spectra from 2 electron detectors are included in each record. The accumulation interval for

13

these spectra is .256 seconds; the first interval ends .128 seconds before time tag, and the second ends .128 seconds after the time tag.

The calibration procedure for conversion of decompressed counts to flux (both differential and integral) is TBD.

Data for this sensor is acquired only while the spacec... ... operated in GTO telemetry mode.

6.2   THDB DATA RECORD STRUCTURE

The THDB files for the AFGL 701-5B consist of a header record followed by a series of data records.

There will be one data record per 0.512 seconds.

HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (70152)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-18	Vacant (Zero fill)

DATA RECORDS:

Word Number

1	UT (milliseconds)
2	Compressed counts:
	Byte 1:Electron integral flux IDE0
	Byte 2:Electron integral flux IDE1
	Byte 3:Electron integral flux IDE2
	Byte 4:Electron integral flux IDE3
3	Byte 1:Electron integral flux IDE4
	Byte 2:Electron integral flux IDE5
	Byte 3:Electron integral flux IDE6
	Byte 4:Electron integral flux IDE7
4	Byte 1:Electron integral flux IDE8
	Byte 2:Electron integral flux IDE9
	Bytes 3-4:Vacant
5	Byte 1:Proton integral flux IDP0
	Byte 2:Proton integral flux IDP1
	Byte 3:Proton integral flux IDP2
	Byte 4:Proton integral flux IDP3

1 4

6	Byte 1:Sensor number for first electron spectrum
	Byte 2:Sensor number for second electron spectrum
	Byte 3:Sensor number for proton spectrum
	Byte 4:Vacant
7-13	Compressed counts (in byte form) for the first 14 point electron spectrum followed by compressed counts (in byte form) for the second 14 point electron spectrum
14-16	Compressed counts (in byte form) for the 12 point proton spectrum
17	Byte 1:Compressed counts for proton coincidence counting rate;
	Byte 2:Compressed counts for proton background counting rate
	Byte 3:Discrete information as follows:

Bit 7 = Telemetry dropout flag (=1 if dropout occurred in the .512 second interval)
Bit 6 = C (Calibration mode flag)
Bit 5 = K
Bit 4 = N
Bit 3 = S
Bit 2 = T
Bit 1 = W
Bit 0 = Telemetry flag. Normally = 0; will be set to 1 if a data gap follows due to a switch to CSM or LASSII telemetry mode.

Byte 4:Vacant

| 18 | Vacant |

Notes:

1. Dummy fill (1 fill) will be used for dropout within a spectra.

2. If dropout occurs for a full .512 seconds resulting in loss of both electron spectra and the proton spectrum, no fill will take place.

3. If dropout occurs such that the sensor number from which a spectra is taken is lost, the sensor number will be 1's filled.

6.3 CALIBRATION FILE RECORD STRUCTURE

The AFGL 701-5B calibration file will be in ASCII form and consist of a series of header records, comment records, electron energy channel records, electron geometric factor records, and proton geometric factor records. There will be one information word per record.

HEADER RECORDS:

Rec.

1 Number of calibration files
2 Number of header records which follow (10) (I)
3 Experiment number (AFGL 701-5B) (CHAR*20)
4 Calibration file version number (I)

15

5	Valid start date for calibration (e.g. 89105) (I)
6	Valid end date for calibration (I)
7	Number of record types in calibration file (5) (I)
8	Number of comment records (I)
9	Number of electron energy channel records (I)
10	Number of electron geometric factor records (I)
11	Number of proton energy channel records (I)
12	Number of proton geometric factor records (I)

COMMENT RECORDS (all records CHAR*80)

Rec.

1-N	Comments

ELECTRON ENERGY CHANNEL RECORDS (all values REAL):

Rec.

1-14	E1 through E14 for electron detector 1
15-28	E1 through E14 for electron detector 2
.	.
.	.
.	.
113-126	E1 through E14 for electron detector 9
127-140	E1 through E14 for electron detector 10

ELECTRON GEOMETRIC FACTOR RECORDS (all values REAL)

Rec.

1-14	G1 through G14 for electron detector 1
15-28	G1 through G14 for electron detector 2
.	.
.	.
.	.
113-126	G1 through G14 for electron detector 9
127-140	G1 through G14 for electron detector 10

PROTON ENERGY CHANNEL RECORDS (all values REAL):

Rec.

1-10	E1 through E10 for proton detector 1
.	.
.	.
.	.
31-40	E1 through E10 for proton detector 4

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PROTON GEOMETRIC FACTOR RECORDS (all values REAL):

Rec.

1-10   G1 through G10 for proton detector 1

   .   .
   .   .
   .   .

31-40   G1 through G10 for proton detector 4

7.0   AFGL 701-6 LOW ENERGY PLASMA ANALYZER (LEPA)

PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL
                                      Dr. David Hardy / PL
                                      Dr. Alan Johnstone / Mullard
                                      Dr. Paul Gough /
                                                Sussex University

7.1   THDB DERIVABLE PARAMETERS

The LEPA THDB consists of a pre-processed file designed for use with follow-on analysis routines. The LEPA package includes two sensor heads, one for electrons and one for ions, and it can be operated in multiple electron and ion modes. With each mode, a set of correlator data is included. Data from all LEPA modes is included in the THDB in half spin blocks. The correlator data associated with each LEPA mode is included in the THDB.

The LEPA data is defined in terms of zones and sectors. Each sensor head is capable of measuring particles within a fan of 120 degrees (zones) in declination and 5.64 degrees of azimuth (sectors). The 120 degree declination range for each sensor is divided into fifteen 8 degree zones. In addition, any of the 8 degree zones can be divided into 8 one degree zones. The counts for each spectral point are log compressed. Each spectra consists of 30 points. The energy range for the spectra is 10eV to 30keV.

Data for this sensor is acquired only while the spacecraft is being operated in GTO and CSM telemetry modes.

7.2 THDB RECORD STRUCTURE

The THDB for the LEPA consists of a header record followed by a series of data records containing half spin blocks of LEPA from all modes. Data records containing information from modes other than MODE0 and MODE10 should be ignored. In MODE0, the data consists of a header section, electron symmetry plane/loss cone data, ion full angular coverage data and correlator data. In MODE10, the data consists of electron and ion full angular coverage data along with correlator data. The LEPA data will be stored in byte form (4 bytes per 32 bit word).

HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (7016)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-1410	Vacant (Zero fill)

DATA RECORDS:

Word Number   Description

1 — UT (milliseconds) - at the start of the minor frame containing the LEPA sync word.

2 — Minor frame word number containing the first of the seven LEPA sync words (1 to 43)

3 — Data flags:

    Byte 1: Telemetry dropout indicator (0=no dropout, 1=dropout somewhere in this half spin block)

    Byte 2: Telemetry mode indicator (value is 0 for GTO and CSM modes; value is 1 the data in this record is dummy filled due to a telemetry mode switch to LASSII A data gap (in time) will follow. Additional information will be written to this file only when the telemetry is switched back to GTO or CSM.)

    Byte 3: Data over-run flag. Value is set to 1 if there were more than 5600 bytes between the 7 LEPA sync words which start a half spin block. The data in this record should be considered 'suspect' if the flag bit is set to 1.

    Byte 4: Vacant

4 — LEPA mode number

5 — Number of data bytes in the LEPA half spin block.

6-1405 — LEPA data from the half spin block stored in byte form. The number of half spin bytes is contained in word 5 of this record. All bytes in excess of that number should be ignored.

1406-1410 — Vacant

The LEPA data contained in the half spin blocks for MODE0 and MODE10 is defined as below.

HEADER SECTION:

Byte	Description:
0-6	7 byte sync word
7-9	24 bit half spin counter (byte 7 =LSB, byte 9=MSB)
10	LEPA mode, HV attenuation mask, command status.
	bits 7-6 = telecommand error
	bit 5 = ion HV mask
	bit 4 = electron HV mask
	bits 3-0 = science mode
11	spare
12-13	EOT (end of transmission for last half spin (12=LSB)
14-15	EOI (end of information for this half spin (14=LSB)
16-17	Last command received or Mode B last byte plus 1 (16=LSB)
18	Magnetometer data 1
19-20	Magnetometer clock 1 (19=voltage, 20=sector)
21	Magnetometer data 2
22-23	Magnetometer clock 2 (22=voltage, 23=sector)
24	Sector imaged as loss cone sector (modes 0-4, 9-A) or starting sector for chorus imaging (modes 5-8)
25	Sector imaged as 90 degree sector (modes 0-4, 9-A) or starting zone for chorus imaging (modes 5-8).
26-27	Sun clock (26=voltage, 27=sector).
28	DR (sun clock divide ratio)
	Clock step in milliseconds = (1024 + DR) / 625
	One half spin = 8192 clock steps upon reset, DR = 120 decimal.
29	MCP readout
	bits 7-4 = ion MCP level
	bits 3-0 = electron MCP level
30-31	A to D count, to be identified from half spin counter (30=LSB)
32-63	Background counts, one byte per sector, integrated over all energies. Ion counts are taken during even numbered sectors and electron counts during odd (sector number = address - 32). The summed counts will be logged.

MODE0 HALF SPIN DATA BLOCK:

Offset	Description
0	Header (64 bytes)
64	Electron symmetry plane (900 bytes)
	Offset + 30*S + V where S = 0, 1 , 2,...,29 and does not get incremented for the loss cone or 90 degree sectors and where V = 0, 1, 2, ... , 29. Counts are logged.
964	Electron loss cone fine (240 bytes)
	Offset + 16*V + FZ where V = 0, 1, 2, ..., 29 and where FZ = 0, 1, 2, ..., 7.
1204	Electron loss cone coarse (480 bytes)
	Offset + 16*V + Z where V = 0, 1, 2, 3, ..., 29 and Z = 0, 1, 2, ..., 15. Counts are logged.
1684	Electron ninety degree - coarse (480 bytes)
	Same as electron loss cone coarse for this mode.

2164	Ion coarse mode (1920 bytes)
	Offset + 60*S + 8*V + [7-Z] where S = 0, 4, 8, ..., 28 and where V = 0, 1, 2, 3, ..., 29 and where Z = 0, 1, 2, ..., 7. Z labels the eight 16 degree zones; counts are logged sums over 4 sectors and two 8 degree zones for each value of V.
4084	Ion loss cone fine
	Same as electron loss cone fine for this mode.
4324	SPACE (Correlator data) (288 bytes)
4612	Data fill (60 bytes)
	This is not part of the LEPA bit stream. The fill is inserted to maintain fixed length records in the THDB.

MODE10 HALF SPIN DATA BLOCK:

Offset	Description
0	Header
64	Electron coarse mode (1920 bytes)
	Offset + 60*S + 8*V + [7-Z] where S = 0, 4, 8, ..., 28 and where V = 0, 1, 2, ..., 29 and where Z = 0, 1, 2, ..., 7. Z labels the eight 16 degree zones and the counts are logged averages over 4 sectors and two 8 degree zones for each value of V.
1984	Electron loss cone fine (240 bytes)
	Same as MODE0.
2224	Ion coarse mode (1920 bytes)
	Same as MODE0.
4144	Ion loss cone fine (240 bytes)
	Same as MODE0
4384	SPACE (Correlator) (288 bytes)

Notes:

1. As an additional precaution against telemetry dropouts, the on-board LEPA software inserts a 2 byte sync pattern into the data stream at intervals of 512 bytes. Numbering the bytes in a half spin from 0, bytes 511+(N*512) and 512+(N*512) where N = 0, 1, 2, 3, ..., 8, 9 comprise a series of 16 bit sync words of the form AAAM (hex) where M = N + 1. The address offsets listed above for the MODE0 and MODE10 data do NOT reflect the presence of the sync words.

2. For a given half spin, the time TB of the beginning of the half spin sync word can be determined from the time of the minor frame at the start of a half spin block and the position of the sync word in the minor frame. Once TB is known, the data in the half spin can be time tagged as follows. The length of the half spin in milliseconds is

$$DT = 8192 * ((1024 + DR) / 625)$$

where DR is the clock divide ratio located at header offset 28. The data will then have been acquired starting at time

$$TR = TB - DT$$

and within the buffer each sector will begin at

$$TS = TR + S * (DT / 32).$$

If finer time resolution is desired, the voltage step interval can be derived as

$$TV = TS + V * (DT/1024).$$

7.3 CALIBRATION FILE RECORD STRUCTURE

The record structure is TBD.

8.0 AFGL 701-7A RELATIVISTIC PROTON DETECTOR
PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL
Al Kolasinski / Aerospace

8.1 THDB DERIVABLE PARAMETERS

The data from this AFGL 701-7A instrument is readout by the Aerospace DPU57. There are 2 Cerenkov detectors (alcohol and silica) each of which produces 4 points every 1.024 seconds. In addition, there are 2 other detectors (Electron Scatter Detector and Minimum Ionizing Detector) each of which produces 4 points per 2.048 seconds. Sensor outputs are in 8 bit compressed form. The THDB data records contain data accumulated over 16 minor frames (2.048 seconds). Data stored consists of compressed counts (in byte form) for two four point spectra from the Cerenkov detectors (detectors 1 and 2); and one set of four point spectra from the Electron Scatter detector and the Minimum Ionizing detector (detectors 3 and 4). The time tag on the THDB data records is associated with the start of the minor frame on which the first of the Cerenkov data sets is placed into the telemetry stream. Data for the Cerenkov detectors was accumulated 1.024 seconds before being readout to telemetry; data for the other two detectors was accumulated 2.048 seconds before being readout to telemetry.

For the 8 bit compressed counts values, the 4 MSBs of the word represent the exponent (e) and the 4 LSBs represent the mantissa (m). The decompression algorithm is as follows:

$$COUNTS = m \text{ if } e = 0,$$

and

$$COUNTS = [\ 2 ** (e-1)]\ *\ [16+ m\ ]\ \text{ if } 0 < e < 16.$$

Conversion of true counts to flux is TBD.

Data for this package is acquired only while the spacecraft telemetry is being operated in GTO mode.

8.2 THDB DATA RECORD STRUCTURE

The THDB files for the AFGL 701-7 consist of a header record followed by a series of data records. There will be one data record per 16 TLM frames (2.048 seconds)

HEADER RECORD (All words 32 bit integers):

Word Number	Description
1	Experiment ID (value is 70171)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-10	Vacant (Zero fill)

DATA RECORDS:

Word Number

1	UT (milliseconds)
2	Byte 1:compressed counts from CA0 - 1st spectra
	Byte 2:compressed counts from CA1 - 1st spectra
	Byte 3:compressed counts from CA2 - 1st spectra
	Byte 4:compressed counts from CA3 - 1st spectra
3	Byte 1:compressed counts from CS0 - 1st spectra
	Byte 2:compressed counts from CS1 - 1st spectra
	Byte 3:compressed counts from CS2 - 1st spectra
	Byte 4:compressed counts from CS3 - 1st spectra
4	Byte 1:compressed counts from CA0 - 2nd spectra
	Byte 2:compressed counts from CA1 - 2nd spectra
	Byte 3:compressed counts from CA2 - 2nd spectra
	Byte 4:compressed counts from CA3 - 2nd spectra
5	Byte 1:compressed counts from CS0 - 2nd spectra
	Byte 2:compressed counts from CS1 - 2nd spectra
	Byte 3:compressed counts from CS2 - 2nd spectra
	Byte 4:compressed counts from CS3 - 2nd spectra
6	Byte 1:compressed counts from RE0
	Byte 2:compressed counts from RE1
	Byte 3:compressed counts from RE2
	Byte 4:compressed counts from RE3
7	Byte 1:compressed counts from RM0
	Byte 2:compressed counts from RM1
	Byte 3:compressed counts from RM2
	Byte 4:compressed counts from RM3

8   Byte 1:
                        Bit 7 = M (1 = Photometer data)
                        Bit 6 = C discrete
                        Bit 5 = K discrete
                        Bit 4 = N discrete
                        Bit 3 = S discrete
                        Bit 2 = T discrete
                        Bit 1 = W discrete
                        Bit 0 = CSM flag. (normally 0; value will be set to 1 if data
                              gap follows due to CSM or LAS)
           Byte 2:Telemetry dropout flag (value will be set to 1 if there is
                        telemetry dropout in the 2.048 second interval covered by
                        this record resulting in dummy fill of any values)
           Bytes 3-4: Vacant
9-10   Vacant

Note:

1.   Counts from each detector will be arranged in order of increasing energy.

8.3   CALIBRATION FILE RECORD STRUCTURE

The AFGL 701-7A calibration file will be in ASCII form and consist of a series of header
records, comment records, and conversion factor records. There will be one information
word per record. The file structure is TBD.

9.0   AFGL 701-7B PROTON SWITCHES
PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL
J. B. Blake / Aerospace

9.1   THDB DERIVABLE PARAMETERS

The proton switch consists of two single detector units in an omnidirectional configuration.
Each unit has 2 channels to measure proton flux. The energy range for unit 1 is 50-107
MeV; for unit 2 the range is 20-84 MeV.

The THDB consists of compressed counts representing proton flux from the 2 channels of
each sensor stored at a rate of once per major frame (4.096 seconds). The counts are
accumulated 4.096 seconds prior to the time tag on the THDB data records.

For the 8 bit compressed counts data, the 4 MSBs of the word represent the exponent (e)
and the 4 LSBs represent the mantissa (m). The decompression algorithm is as follows:

$$COUNTS = m \text{ if } e = 0,$$

and

$$COUNTS = [\,2^{**}(e\text{-}1)\,] * [16+m\,]\ \text{if}\ 0 < e < 16.$$

The formula for the conversion of decompressed counts to flux (in P+/cm**2-sec-ster) for channel i is:

$$FLUX(i) = COUNTS(i) / (AP * GF(i))$$

where AP is the accumulation period (nominally 4.096 seconds) and GF(i) is the geometric factor for channel i.

Data for this sensor is acquired only while the spacecraft is being operated in GTO telemetry mode.

9.2 THDB DATA RECORD STRUCTURE

The THDB files for the AFGL 701-7B consist of a header record followed by a series of data records. The header record is in 32 bit positive integer form. There will be one data record per 4.096 seconds

HEADER RECORD (All words 32 bit integers):

Word Number	Description
1	Experiment ID (70172)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-8	Vacant

DATA RECORDS:

Word Number

1	UT (milliseconds)
2	Compressed counts for integral flux PSU(0) (50-75MeV)
3	Compressed counts " " " PSU(1) (20-50MeV)
4	Compressed counts " " " PSL(0) (50-105MeV)
5	Compressed counts " " " PSL(1) (20-83MeV)
6	Byte 1:

        Bit 7 = Vacant
        Bit 6 = C discrete
        Bit 5 = K discrete
        Bit 4 = N discrete
        Bit 3 = S discrete
        Bit 2 = T discrete
        Bit 1 = W discrete
        Bit 0 = Telemetry flag (normally 0; will be set to 1
        if data gap due to CSM or LAS follows)

Byte 2:Telemetry dropout flag (value will be 1 if any of the values
stored were dummy filled due to telemetry dropout).
Bytes 3-4: Vacant

7-8   Vacant

9.3   CALIBRATION FILE RECORD STRUCTURE

The AFGL 701-7B calibration file will consist of ASCII data. The file will contain a series
of header records, comment records, energy value records, and geometric factor records.
There will be one information word per record.

HEADER RECORDS:

Rec.

1   Number of calibration files
2   Number of Header records which follow (9) (I)
3   Experiment Number (AFGL 7017B) (CHAR*20)
4   Calibration version number (I)
5   Valid start date for calibration. (e.g. 89105) (I)
6   Valid end date for calibration (I)
7   Number of record types in calibration file (3) (I)
8   Number of Comment records - if zero, none. (I)
9   Number of Energy Channel records (I)
10   Number of Geometric Factor records (I)

COMMENT RECORDS (all records CHAR*80):

Rec.

1-N   Comment records

ENERGY CHANNEL RECORDS (all words REAL):

Rec.

1   EMIN for PSU(0)
2   EMAX for PSU(0)
3   EMIN for PSU(1)
4   EMAX for PSU(1)
5   EMIN for PSL(0)
6   EMAX for PSL(0)
7   EMIN for PSL(1)
8   EMAX for PSL(1)

GEOMETRIC FACTOR RECORDS (all words REAL):

Rec.

1   GF for PSU(0)
2   GF for PSU(1)
3   GF for PSL(0)
4   GF for PSL(1)

10.0   AFGL 701-8,-9 PROTON TELESCOPE (PROTEL)
PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL
Lt. Michael Violet / PL
Dr. Susan Gussenhoven / PL

10.1   THDB DERIVABLE PARAMETERS

The PROTEL THDB consists of decompressed counts representing differential flux for a 24 point proton spectra (1-100MeV); heavy ion dose in 10 channels (1.4-100MeV); twelve singles readouts from the high energy sensor head; and nine singles readouts from the low energy sensor head. This data is acquired every 1.024 seconds. Instrument bilevel and analog data is stored once per masterframe (4.096 seconds). Data records are generated in 4.096 second blocks. The spectra, dose, and singles data is sampled 1.024 seconds before being readout to telemetry.

For the 24 proton channels, the conversion from true counts to differential flux is by means of a multiplicative constant (geometric factor) for each channel. Thus,

$$DIFF\ FLUX(i) = PCOUNTS(i) * GF(i),$$

where PCOUNTS(i) is the decompressed counts for proton channel(i), and GF(i) is the associated geometric factor.

The calibration procedure for the dose data is also by means of one multiplicative factor per channel. Thus,

$$DOSE(i) = DCOUNTS(i) * F(i),$$

where DCOUNTS(i) represents the decompressed counts for dose channel(i), and F(i) is the associated multiplicative factor.

Data for this sensor is acquired in all spacecraft telemetry modes.

10.2   THDB DATA RECORD STRUCTURE

The AFGL 701-8,-9 THDB files consist of a header record followed by a series of data records. Each data record is made up of data accumulated over a master frame (4.096 seconds).

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HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (value is 70189)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-230	Vacant (Zero fill)

DATA RECORDS:

Word Number	Description
1	UT (Milliseconds)
2-9	Decompressed counts for the 8 LE differential proton spectra
10-25	Decompressed counts for the 16 HE differential proton spectra
26-35	Decompressed counts for the 10 heavy ion dose measurements
36-56	Decompressed counts for LE singles channels (D1A, D12A, D123A, D134A, D5, D1, D2, D3, D4) followed HE singles channels D1A, D12A, D123A, D134A, D145A, D6, Dr, D1, D2, D3, D4, D5.
57-111	Repeat the order of words 2-56 for the next 1.024s.
112-166	" "
167-221	" "
222-226	Bilevels, analogs, and dropout flag in byte form and in the order B29, B30, A221-A237, dropout flag.
227-230	Vacant

Notes:

1. The dropout flag will be set to 1 if there is dropout anywhere within the master frame.

2. Dropout within a spectra will be 1 filled.

10.3   CALIBRATION FILE RECORD STRUCTURE

The AFGL 701-8/-9 calibration file will consist of ASCII data. The file will contain a series of header records, comment records, energy value records, geometric factor records, and channel dependent constant records. There will be one information word per record.

HEADER RECORDS:

Rec.

1	Number of calibration files
2	Number of Header records which follow (9) (I)
3	Experiment Number (AFGL 7018A) (CHAR*20)

4	Calibration version number (I)
5	Valid start date for calibration. (e.g. 89105) (I)
6	Valid end date for calibration (I)
7	Number of record types in calibration file (5) (I)
8	Number of Comment records
9	Number of Proton Energy Channel records (I)
10	Number of Proton Geometric Factor records (I)
11	Number of Dose Threshold Energy records. (I)
12	Number of Dose Calibration factor records. (i)

COMMENT RECORDS (all records CHAR*80):

Rec.

1-N   Comment records

PROTON ENERGY CHANNEL RECORDS (all words REAL):

Rec.

1-8	LE E1
2	LE E2
3	LE E3
.	.
.	.
.	.
8	LE E8
9	HE E1
.	.
.	.
.	.
.	.
24	HE16

PROTON CHANNEL GEOMETRIC FACTOR RECORDS (all words REAL):

Rec.

| 1-8 | LE Channel geometric factors |
| 9-24 | HE Channel geometric factors |

DOSE CHANNEL ENERGY THRESHOLD RECORDS (all words REAL)

Rec.

1-10   Dose channel energy thresholds

DOSE CHANNEL CALIBRATION CONSTANT RECORDS (all words REAL):

Rec.

1-10   Dose channel calibration constants.

11.0 AFGL 701-11A MAGNETOSPHERIC ION COMPOSITION SENSOR (MICS)

PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL

Berend Wilken / Max Planck

11.1 THDB DERIVABLE PARAMETERS

Due to the complexity of algorithm development, the 701-11A THDB is a pre-processed file. Data records consist of a masterframe of data containing a time tag followed by the full set of instrument telemetry data from DPUA. The telemetry data is stored in byte form.

The 701-11A Instrument memory holds 8 tables of constituents; each table designates 8 constituents for analysis. Tables can be removed and replaced by new tables by uplink command.

Upon completion of algorithm development, the derivable parameters from the DPU will include:

1.   Page ID number
2.   The 16 (mass) by 32 (m/q) matrix of counts accumulated by each matrix element every 65.536 seconds.
3.   In normal mode, 8 m/q values are selected for energy analysis (nominally 30 keV/g to 400 keV/q) and a 32 point energy spectrum is produced every 8.192 seconds (2 major frames); in auroral mode, 8 m/q values are selected and a 16 point energy spectrum is produced every 4.096 seconds. Values of m/q to be included on each page are H+, He+, He++, O+ and O++.

Data for this sensor is not acquired during spacecraft LASSII telemetry mode.

11.2 THDB DATA RECORD STRUCTURE

The THDB file consist of a header record followed by a series of data records containing the DPUA data. There is one data record per masterframe (4.096 seconds). The DPUA telemetry data is stored in byte form.

HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (701111)
2	Year
3	Day of Year

4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-130	Vacant (Zero fill)

Word Number

1	UT (ms)
2-5	DPUA data from telemetry minor frame 0
6-9	DPUA data from telemetry minor frame 1
10-13	DPUA data from telemetry minor frame 2
.	.
.	.
.	.
126-129	DPUA data from telemetry minor frame 31
130	Byte 4 (MS BYTE):TLM mode indicator

        Bit 0 (LSB) = Telemetry indicator. Value is 0 when spacecraft TLM is in GTO mode. Value will be set to 1 when a data gap follows due to a switch to either CSM or LASSII modes.

    Byte 3:Dropout indicator

        Bit 0 = 1 if there is 1's fill due to telemetry dropout anywhere is this record.

    Bytes 2 and 1 are vacant.

Notes:

1. In auroral mode the "32 point spectra" values will be replaced by two successive 16 point spectra values for an effective rate of 4.096 seconds per spectra.

2. The word order for the matrix values is:

$$(((M(i),M_Q(j)),i=0,15),j=0,31).$$

11.3   CALIBRATION FILE RECORD STRUCTURE

The format of the calibration record is TBD.

11.4   PAGE NUMBER FILE RECORD STRUCTURE

The format of the Page Number record is TBD.

12.0 AFGL 701-11B LOW ENERGY MAGNETOSPHERIC ION COMPOSITION SENSOR (LOMICS)
AFGL 701-11C HEAVY ION TELESCOPE (HIT)
PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL
Ted Fritz /
Los Alamos National Lab

12.1 THDB DERIVABLE PARAMETERS

Due to the complexity of algorithm development, the 701-11B THDB is a pre-processed file. Data records consist of a masterframe of data containing a time tag followed by the full set of instrument telemetry data from DPUB. The telemetry data is stored in byte form.

LOMICS and HIT time share DPUB. The sensor package can be commanded into either mode or operate in an alternating pattern. Indications are that there may be problems with the LOMICS sensor and, hence, there may be little data available from it. Data taking periods for each instrument will be some integral multiple of 65.536s (16 major frames).

The derivable LOMICS parameters are as follows:

1.   In normal mode six constituents are selected for energy analysis; m/q values of 1,2,4,8,16, plus one additional commandable constituent. There are 8 pages of choices; each page holds the 6 selected constituents. A 32 point energy spectrum (nominally between 40 eV/q and 40 keV/q) will be produced for each constituent every 4.096 seconds (major frame).

2.   A table ID number will be included for use with the page number which cross references date, page numbers, and m/q values in each page. The table ID and page number file are necessary because constituent identification cannot be made from the telemetry data.

3.   The ESA step data.

Upon completion of algorithm development, the derivable HIT parameters are as follows:

1.   From the 7 pages of choices each of which identifies 12 matrix elements, the selected elements are sent through rate scalars and are readout every 0.256 seconds.

2.   A 512 element matrix of 32 energies by 16 masses. In the 65.536 seconds, counts are accumulated in each matrix element.

Data from this package is not acquired during spacecraft LASSII telemetry mode.

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12.2 THDB RECORD STRUCTURES

The LOMICS/HIT THDB file consists of a header record followed by a series of data records. Information in the header record is in 32 bit integer form. The data records are time tagged to the start of the masterframe and contain the full set of DPUB data.

HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (7011123)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-164	Vacant (Zero fill)

DATA RECORDS:

Word Number	Description
1	UT (milliseconds) at start of the masterframe
2-6	DPUB data from minor frame 0
7-11	DPUB data from minor frame 1
.	.
.	.
157-161	DPUB data from minor frame 31
162	Byte 1:
	Dropout indicator (normal is 0; 1 if there is 1's fill due to telemetry dropout anywhere in this masterframe)
	Byte 2:
	LASSII/CSM mode indicator (value is 1 if a data gap follows due to a switch in telemetry mode from GTO to either LASSII or CSM).
	Bytes 3-4:
	Vacant
163-164	Vacant

12.3 CALIBRATION FILE RECORD STRUCTURE

The 701-11B and 701-11C Calibration File structures are TBD.

12.4 PAGE NUMBER FILE RECORD STRUCTURE

The 701-11B and 701-11C Page Number File record structures are TBD.

13.0 AFGL 701-13-1 FLUXGATE MAGNETOMETER
PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL
Dr. Howard Singer / PL

13.1 THDB DERIVABLE PARAMETERS

The magnetic field file is a replica of the magnetic field file contained on the Agency Tapes sent to the various CRRES user agencies. It consists of the millisecond time word, the 12 bit telemetered digital data corresponding to the x, y, z science magnetometer sensor outputs, the analog science magnetometer data, a temperature monitor, two 8 bit telemetry words which contain bilevels, and the analog values from the spacecraft attitude magnetometers. The 12 bit digital data is in 2's complement form, with a range of -2048 to 2047. Universal Time in milliseconds) is contained in a 32 bit word. The 12 bit digital values are stored in 16 bit words. Bits 12 and 13 are designators identifying the sensor range. These variable gain outputs are written to the file tape at a rate of 8 times per second. The low gain digital values are at a rate of 2 points per second. The high gain analog data are included at a rate of 4 points per masterframe; the low gain analogs occur once per masterframe. The temperature monitor and bilevel words occur once per masterframe. The magnetometer analogs, temperature monitor and bilevels are stored in their 8 bit telemetry form. The spacecraft (X,Y,Z) attitude magnetometers for both high gain and low gain are included in 8 bit analog form at their full rate of 4 points per masterframe. A flag bit is set to 1 whenever the spacecraft telemetry is in LASSII mode. Each record contains 16 master frames of data (approximately 65.536 seconds).

Telemetry dropouts will be 1's filled unless a full master frame is missing.

The Fluxgate Magnetometer Co-Investigator has made available a file of calibration data (on an orbit by orbit basis) and VAX compatible routines to read the file. The information which is contained in a special directory on the PL VAX cluster is available via the Space Physics Analysis Network (SPAN).

Data from this sensor is not acquired during spacecraft LASSII telemetry mode.

13.2 THDB DATA RECORD STRUCTURE

The THDB files for the magnetometer consist of a header record followed by a series of data records. The header record is in 32 bit positive integer form. For the data records, all words are 32 bits; in the bit numbering sequence, bit 32 is the MSB of the 32 bit word; bit 1 is the LSB.

HEADER RECORD (All words 32 bit integers):

Word Number	Description
1	Experiment ID (701131)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-1200	Vacant (Zero fill)

DATA RECORDS:

Word	Bits	Description
1	32-1	UT (milliseconds) at beginning of master frame
2	32-17	BXL(1)
	16-1	BYL(1)
3	32-17	BZL(1)
	16-1	BX(1)
4	32-17	BY(1)
	16-1	BZ(1)
5	32-17	BX(2)
	16-1	BY(2)
6	32-17	BZ(2)
	16-1	BX(3)
.	.	.
.	.	.
.	.	.
9	32-17	BZ(4)
	16-1	BXL(2)
10	32-17	BYL(2)
	16-1	BZL(2)
11	32-17	BX(5)
	16-1	BY(5)
.	.	.
.	.	.
.	.	.
16	32-17	BY(8)
	16-1	BZ(8)
17-32	Repeat order of words 1-16 for next second	
33-48	Repeat order of words 1-16 for next second	
49-64	Repeat order of words 1-16 for next second	
65	32-25	BXAL(1)
	24-17	BYAL(1)
	16-9	BZAL(1)
	8-1	BXA(1)
66	32-25	BYA(1)
	24-17	BZA(1)
	16-9	BXA(2)
	8-1	BYA(2)

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67	32-25	BZA(2)
	24-17	BXA(3)
	16-9	BYA(3)
	8-1	BZA(3)
68	32-25	BXA(4)
	24-17	BYA(4)
	16-9	BZA(4)
	8-1	A241 (Temperature 1B monitor)
69	32-25	B1
	24-17	B2
	16-9	B30
	8-1	Telemetry flag (0=GTO mode, 1=LASSI mode)
70	32-25	XSCH(1)
	24-17	XSCH(2)
	16-9	XSCH(3)
	8-1	XSCH(4)
71	32-25	YSCH(1)
	24-17	YSCH(2)
	16-9	YSCH(3)
	8-1	YSCH(4)
72	32-25	ZSCH(1)
	24-17	ZSCH(2)
	16-9	ZSCH(3)
	8-1	ZSCH(4)
73	32-25	XSCL(1)
	24-17	XSCL(2)
	16-9	XSCL(3)
	8-1	XSCL(4)
74	32-25	YSCL(1)
	24-17	YSCL(2)
	16-9	YSCL(3)
	8-1	YSCL(4)
75	32-25	ZSCL(1)
	24-17	ZSCL(2)
	16-9	ZSCL(3)
	8-1	ZSCL(4)
76-150	Repeat order of words 1-75 for 2nd master frame	
151-225	Repeat order of words 1-75 for 3rd master frame	
.	.	
.	.	
.	.	
1126-1200	Repeat order of words 1-75 for 16th master frame	

13.3 CALIBRATION FILE RECORD STRUCTURE

The format of the calibration file is TBD.

14.0   AFGL 701-13-2 SEARCH COIL MAGNETOMETER
         AFGL 701-15 PASSIVE PLASMA SOUNDER
         PRINCIPAL INVESTIGATOR: E. Gary Mullen / PL
                                      Dr. Roger Anderson /
                                          University of Iowa
                                      Dr. Donald Gurnett /
                                          University of Iowa
                                      Dr. Howard Singer / PL

14.1 THDB DERIVABLE PARAMETERS

The THDB consists of one data record every 8 major frames (32.768 sec). There is a 14 point SA spectra every minor frame. A code word precedes each set of 8 SA spectra to indicate the input data source (1 = passive plasma sounder plasma sounder (E), 2= Search coil magnetometer (B), 3= Langmuir probe (L)). For the SFR, a code word precedes the spectra data to indicate the input data. All spectra points are arranged from lowest to highest frequency. Each record has a total of 256 SA spectra; 1 band 1 SFR 32 point spectrum; 2 band 2 SFR 32 point spectra; 4 band 3 SFR 32 point spectra; and 4 band 4 SFR 32 point spectra. All telemetry words are stored in PCM counts (8 bits).

The frequency range for the SFR is as follows:

Band No.	Frequency Range	Pts/Sec	Sec/Spectrum
1	104Hz-799Hz	1	32
2	836Hz-6.23kHz	2	16
3	6.69kHz-49.9kHz	4	8
4	3.5kHz-399kHz	4	8

For the SA the frequency range is 5.6Hz-10kHz.

The preliminary conversion of the SFR and SA data from telemetry counts to science units involves the use of formulas and look up tables.

For the Swept Frequency Receiver, the calibration procedure is as follows:

For the E and L data,

$$\text{Spectral Density } (v^2/m^2/Hz) = [COUNTS(i,j)*M(i,j)*G(k,l)/EAL]^2 / EB$$

For B,

$$\text{Spectral Density } (nT)^2/Hz = [COUNTS(i,j)*M(i,j)*G(k,l)]^2 / EB$$

where COUNTS(i,j) represents the PCM counts for the four bands (i) and the 256 possible values of the 8 bit readouts (j); M(i,j) is a 4 X 256 matrix to convert the PCM counts to voltage; G(k,l) is a 3 X 128 table of relative gain versus frequency factors for the 3 antennas and the 128 channels; EAL is the effective antenna length; and EB is the effective band width.

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The calibration procedure for the Spectrum Analyzer is similar to that of the SFR.

For E and L data, the calibration equation is:

$$\text{Spectral Density}(v^2/m^2/Hz)=[\text{COUNTS}(i,j)*M(i,j)*G(k,l))/(\text{EAL})]^2/\text{EB}$$

where COUNTS(i,j) represents the 8 bit PCM counts for the 14 frequencies (i) and 256 (j) possible values of the 8 bit data; M(i,j) is a 14 X 256 matrix to convert COUNTS(i,j) from counts to voltage; G(k,l) is a 3 X 14 gain factor matrix for the 3 antennas and 14 frequencies; EAL is the effective antenna length; and EB is the effective bandwidth.

For the B data, the same equation may be used if EAL is set to 1.

The calibrated B units for the SA are [nT]^2 / Hz.

Data from this package is not acquired during spacecraft LASSII telemetry mode.

14.2 THDB DATA RECORD STRUCTURE

The THDB files for this data consist of a header record followed by a series of data records. The header record is in 32 bit positive integer form. There is one data record every 8 major frames (32.768 sec). There is a 14 point SA spectra every minor frame. A code word precedes each 8 sets of spectra to indicate the data type (1=passive plasma sounder, 2= Search coil magnetometer, 3= Langmuir probe). For the SFR, a code word precedes the data which indicates data type and whether the data type changed within the 8 major frames. Code word values are: 1 = passive plasma sounder, 2 = search coil magnetometer, 3 = Langmuir, 4 = data began as passive plasma sounder but did not end as passive plasma sounder, 5 = data began but did not end as search coil, 6 = data began as Langmuir but did not end as Langmuir. Spectra points occurring after the state change are 1 filled. Spectra points missing due to TLM dropout are also 1 filled. All spectra points are arranged from lowest to highest frequency. Each record has a total of 256 SA spectra: 1 band 1 SFR 32 point spectrum; 2 band 2 SFR 32 point spectra; 4 band 3 SFR 32 point spectra; and 4 band 4 SFR 32 point spectra. All telemetry words are in PCM counts (8 bits).

HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (701132)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-1032	Vacant (Zero fill)

DATA RECORDS:

Word Number	Description
1	UT (milliseconds)
2	Code word for next 8 SA spectra
3	SA points 1 thru 4 (4 8-bit bytes)
4	" " 5 thru 8
5	" " 9 thru 12
6	" " 13,14 and 1,2 from next spectra
7	" " 3 thru 6
.	.
.	.
.	.
30	" " 11 thru 14
31-59	Repeat order of words 2-30 for next 8 spectra
60-88	Repeat order of words 2-30 for next 8 spectra
.	. . .
.	.
.	.
901-929	" " " " " " last 8 spectra
930	vacant
931	SFR code word
932-939	32 point band 1 spectrum
940-947	" " band 2 spectrum
948-955	" " band 2 spectrum
956-987	Four 32 point band 3 spectra
988-1019	Four 32 point band 4 spectra
1020	LVPS,temp,command state and a vacant byte (from first major frame)
1021-1028	32 values of the Berkeley FDM taken once per second (32 bytes)
1029-1030	Telemetry mode indicator once per masterframe; 0 = GTO, 1= LASSII (and hence a data gap will follow); 2 = CSM (and hence some IOWA words are invalid). (8 bytes)
1031	Dropout flag (value=1 if dropout in 8 masterframes
1032	Vacant

14.3 CALIBRATION FILE RECORD STRUCTURE

The Searchcoil Magnetometer / Passive Plasma Sounder calibration file will consist of ASCII data. The file will contain a series of header records, comment records, center frequency records, PCM counts to volts records, gain factor records, effective antenna length records, and effective bandwidth records. There will be one information word per record.

HEADER RECORDS:

Rec.

1	Number of calibration files
2	Number of Header records which follow (14) (I)
3	Experiment Number (AFGL 701-13-2) (CHAR*20)
4	Calibration version number (I)

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5	Valid start date for calibration. (e.g. 89105) (I)
6	Valid end date for calibration (I)
7	Number of record types in calibration file (9) (I)
8	Number of Comment records (I)
9	Number of Center frequency records for the SA (14)
10	Number of Center frequency records for the SFR (132)
11	Number of SA PCM Counts to Volts records (256 X 14= 3584)
12	Number of SFR PCM Counts to Volts records (256 X 128= 32768)
13	Gain Factors for SA (14 X 3= 42)
14	Gain Factors for SFR (128 X 3= 384)
15	Effective Antenna Length (EAL) records (3)
16	Effective Bandwidth (EB) records (3)

COMMENT RECORDS (all records CHAR*80):

Rec.

1-N   Comment records

SA CENTER FREQUENCY RECORDS (all words REAL):

Rec.

1	Channel 1
2	Channel 2
.	.
.	.
.	.
14	Channel 14

SFR CENTER FREQUENCY RECORDS (all words REAL):

Rec.

1	Channel 1 (Band 1)
2	Channel 2 (Band 1)
.	.
.	.
.	.
32	Channel 32 (Band 1)
33	Channel 1 (Band 2)
34	Channel 2 (Band 2)
.	.
.	.
.	.
64	Channel 32 (Band 2)
65	Channel 1 (Band 3)
66	Channel 2 (Band 3)
.	.
.	.
.	.
96	Channel 32 (Band 3)
97	Channel 1 (Band 4)

98   Channel 2 (Band 4)

.   .

.   .

.   .

128   Channel 32 (Band 4)

SA PCM COUNTS TO VOLTS RECORDS (all values real):

There are 256 values (representing PCM counts 0-255) for SA channels 1-14.

Rec.

1-256	Conversions for channel 1
257-512	Conversions for channel 2
513-768	Conversions for channel 3

.   .

.   .

.   .

3329-3584   Conversions for Channel 14

SFR PCM COUNTS TO VOLTS RECORDS (all values real):

There are 256 values (representing PCM counts 0-255) for SFR channels 1-32 (Band 1 followed by Band 2, Band 3, then Band 4).

Rec.

1-8192	Conversions for Band 1
8193-16384	Conversions for Band 2
16385-24576	Conversions for Band 3
24577-32768	Conversions for Band 4

SA GAIN FACTOR RECORDS (all values real):

There are 42 values; one for each of the 14 channels for the E-antenna, the B-antenna, and the L-antenna.

Rec.

1-14	Gain factors for the 14 channels for the E-antenna
15-28	Gain factors for the 14 channels for the B-antenna
16-42	Gain factors for the 14 channels for the L-antenna

SFR GAIN FACTOR RECORDS (all values real):

There are 384 values; one for each of the 128 channels for the E-antenna, the B-antenna, and the L-antenna.

Rec.

1-32	Gain factors for the 32 Band 1 channels for the E-antenna
33-64	Gain factors for the 32 Band 2 channels for the E-antenna
65-96	Gain factors for the 32 Band 3 channels for the E-antenna

97-128	Gain factors for the 32 Band 4 channels for the E-antenna
129-160	Gain factors for the 32 Band 1 channels for the B-antenna
161-192	Gain factors for the 32 Band 2 channels for the B-antenna
193-224	Gain factors for the 32 Band 3 channels for the B-antenna
225-256	Gain factors for the 32 Band 4 channels for the B-antenna
257-288	Gain factors for the 32 Band 1 channels for the L-antenna
289-320	Gain factors for the 32 Band 2 channels for the L-antenna
321-352	Gain factors for the 32 Band 3 channels for the L-antenna
353-384	Gain factors for the 32 Band 4 channels for the L-antenna

EFFECTIVE ANTENNA LENGTH RECORDS (values are REAL):

Rec.

1	Effective antenna length for the E-antenna
2	Effective antenna length for the B-antenna
3	Effective antenna length for the L-antenna

EFFECTIVE BANDWIDTH RECORDS (values are REAL):

Rec.

1	Effective Bandwidth for the E-antenna
2	Effective Bandwidth for the B-antenna
3	Effective Bandwidth for the L-antenna

15.0 AFGL 701-14 LANGMUIR PROBE

PRINCIPAL INVESTIGATOR:

E. Gary Mullen / PL
Dr. Forrest Mozer /
    Univ. of Cal. Berkeley
Dr. John Wygant /
    Univ. of Cal. Berkeley
Dr. Nelson Maynard / PL
Dr. Michael Smiddy / PL
Dr. Howard Singer / PL

15.1 THDB DERIVABLE PARAMETERS

There are two separate data bases generated for the Berkeley microprocessor: the Spin Fit Coefficient file; and the Bandpass, Spacecraft Potential and E-Field file.

THDB parameter availability and data rates for the AFGL 701-14 are a function of instrument mode.

The derivable parameters from the spin fit THDB are:

Least square fit coefficients to the electric field data as measured by the cylinders. The coefficients for the spheres will be included whenever they are available. The data rate for each set of coefficients is once per spin.

The derivable parameters from the Bandpass, Spacecraft Potential and E-Field file (at one sample per second) are:

1. Bandpass data at 3 frequencies: 32Hz, 256Hz and 1024Hz.
   The data from the spheres is fed through the three bandpass filters. The bandpass values are valid only when test/calibrate is not in progress and when there are no bias sweeps.

2. Spacecraft potential.
   The quantities needed for the determination of spacecraft potential are V1, V2, V3 and V4. These quantities may not be available during burst memory playback. The V1 and V2 are valid only when the spheres are in voltage mode and there is no test/calibrate or bias sweeps.

3. High time resolution electric field data.
   The quantities required for the determination of high time resolution E-Field measurements are V12 and V34. These quantities may not be available during burst memory playback. The V12 data is valid only when the spheres are in E-Field (voltage) mode.

Calibration procedures to convert the THDB data to science units are not yet finalized.

Data from this sensor is not acquired during spacecraft LASSII telemetry mode.

15.2 THDB DATA RECORD STRUCTURE

There will be three separate data bases generated for the Berkeley microprocessor: the Spin Fit Coefficient file; the Bandpass, Spacecraft Potential and E-Field file; and the Langmuir Probe Density/Temperature file.

15.2.1   SPIN FIT COEFFICIENT FILE.

HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (701141)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-12	Vacant (Zero fill)

DATA RECORDS:

Word Number	Description
1	UT (at start of minor frame containing the beginning of a new set of spin fit readouts)
2	Data type flag (0 = results from spheres; 1 = results from cylinders)
3	AHI (24 bits right adjusted in 32 bit word)

4	ALO (24 bits right adjusted in 32 bit word)	
5	B (24 bits right adjusted in 32 bit word)	
6	C (24 bits right adjusted in 32 bit word)	
7	SIGMA (24 bits right adjusted in 32 bit word)	
8	SPIN PERIOD (2 right adjusted bytes from the DSC with DSC word 120 as the least significant byte of the 32 bit word)	
9	Byte 1:	N (number of points remaining in the fit)
	Byte 2:	BIAS1 (in PCM counts)
	Byte 3:	BIAS2 " "
	Byte 4:	BIAS3 " "
10	Byte 1:	BIAS4 " "
	Byte 2:	STUB1 " "
	Byte 3:	STUB2 " "
	Byte 4:	GUARD1 " "
11	Byte 1:	GUARD2 " "
	Bytes 2-4:	Vacant
12	Bytes 1-4:	Vacant

Note: The spin fit coefficients will be placed in the THDB by storing the 24 bit form into 32 bit words. The 24 bits represent a sign bit (1=negative), a 7 bit exponent, and a 16 bit mantissa. The formula to be used in converting the sign, exponent (E), and mantissa (M) to a floating point number is as follows:

$$REAL = (SIGN) * [\, 2^{**}(E - 64] * [M / 32768.].$$

15.2.2 BAND PASS, SPACECRAFT POTENTIAL, AND E-FIELD FILE.

This data base consists of a header record, an HX channel identification record, a LX channel identification record, and a series of data records. The LX/HX channel identification records consist of the first set of LX/HX identifiers in the DSC for this orbit. These values are likely to remain constant for an entire orbit since the channel assignments can be changed only by uplink command. The full DSC is included in the data records so that any changes can be identified.

HEADER RECORD (All words 32 bit integers):

Word Number	Description
1	Experiment ID (701142)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-12	Vacant (Zero fill)

HX CHANNEL IDENTIFICATION RECORD:

Word Number	Description	
1	Byte 1:	HX(0) identifier
	Byte 2:	HX(1) identifier
	Byte 3:	HX(2) identifier
	Byte 4:	HX(3) identifier
2	Byte 1:	HX(4) identifier
	Byte 2:	HX(5) identifier
	Byte 3:	HX(6) identifier
	Byte 4:	HX(7) identifier
3	Byte 1:	HX(8) identifier
	Byte 2:	HX(9) identifier
	Byte 3:	HX(10) identifier
	Byte 4:	HX(11) identifier
4	Byte 1:	HX(12) identifier
	Byte 2:	HX(13) identifier
	Byte 3:	HX(14) identifier
	Byte 4:	HX(15) identifier
5-12	Vacant	

HX CHANNEL IDENTIFICATION RECORD:

Word Number	Description	
1	Byte 1:	LX(0) identifier
	Byte 2:	LX(1) identifier
	Byte 3:	LX(2) identifier
	Byte 4:	LX(3) identifier
2	Byte 1:	LX(4) identifier
	Byte 2:	LX(5) identifier
	Byte 3:	LX(6) identifier
	Byte 4:	LX(7) identifier
3	Byte 1:	LX(8) identifier
	Byte 2:	LX(9) identifier
	Byte 3:	LX(10) identifier
	Byte 4:	LX(11) identifier
4	Byte 1:	LX(12) identifier
	Byte 2:	LX(13) identifier
	Byte 3:	LX(14) identifier
	Byte 4:	LX(15) identifier
5	Byte 1:	LX(16) identifier
	Byte 2:	LX(17) identifier
	Byte 3:	LX(18) identifier
	Byte 4:	LX(19) identifier
6	Byte 1:	LX(20) identifier
	Byte 2:	LX(21) identifier
	Byte 3:	LX(22) identifier
	Byte 4:	LX(23) identifier
7	Byte 1:	LX(24) identifier
	Byte 2:	LX(25) identifier
	Byte 3:	LX(26) identifier
	Byte 4:	LX(27) identifier

8	Byte 1:	LX(28) identifier
	Byte 2:	LX(29) identifier
	Byte 3:	LX(30) identifier
	Byte 4:	LX(31) identifier
9-12	Vacant	

DATA RECORDS:

Word Number		Description
1		UT (at start of minor frame for this 1.024 second period (minor frame 0 (mod 8))
2	Bits 31-16:	V1
	Bits 15-0:	V2
3	Bits 31-16:	V3
	Bits 15-0:	V4
4	Bits 31-16:	V12
	Bits 15-0:	V34
5	Bits 31-16:	F1
	Bits 15-0:	F2
6	Bits 31-16:	F3
	Bits 15-0:	Vacant
7	Byte 1:	TEMP2 monitor
	Byte 2:	DSC word 52
	Byte 3:	DSC word 53
	Byte 4:	DSC word 54
8	Byte 1:	FDM (from minor frame 0 (mod8)
	Byte 2:	Minor frame number at the start of this 1 second interval
	Byte 3:	First DSC value in this time interval
	Byte 4:	Second DSC value in this time interval
9	Byte 1:	Third DSC value in this time interval
	Byte 2:	Fourth DSC value in this time interval
	Byte 3:	Dropout flag; (value is 1 if there is telemetry dropout in this 1 second interval)
	Byte 4:	CSM / LASSII flag; (value is 1 if a data gap follows this record due to a switch to CSM or LASSII telemetry modes)
10-12	Vacant	

Notes:

1. The 12 bit values are stored right-adjusted within the 16 bit locations. The decimal value of the 12 bit telemetry data ranges between -2048 and +2047. To obtain the proper value from these 12 bits, subtract 4096 if the value exceeds +2047. The 13th bit is the gain bit for the readout (0 = low gain, 1 = high gain). The 14th bit will be set to 1 if the parameter is a candidate for over-write by burst memory readout. If this bit is 1 and the 'P' bit from the FDM is 1, the value is invalid.

2. The values of V1, V2, V3, V4, V12, V34, F1, F2, and F3 will be 1's filled if they were not available on any of the LX or HX channels. These values should be considered to be invalid if the sensor is in test/calibrate mode (FDM 'T' bit equal to 1).

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3. The V1, V2, and V12 values are invalid if the spheres are in current mode (FDM 'M' bit equal to 1) and may be invalid if a bias sweep is in progress (FDM 'S' bit equal 1).

4. The V3, V4, and V34 values may be invalid if a bias sweep is in progress.

15.3 CALIBRATION FILE RECORD STRUCTURE

The AFGL 701-14 calibration file will consist of ASCII data. The file will contain a series of header records, comment records, gain/offset records, linear conversion factor records, and L value records. There will be one information word per record.

HEADER RECORDS:

Rec.

1	Number of calibration files
2	Number of Header records which follow (9) (I)
3	Experiment Number (AFGL 70114) (CHAR*20)
4	Calibration version number (I)
5	Valid start date for calibration. (e.g. 89105) (I)
6	Valid end date for calibration (I)
7	Number of record types in calibration file (4) (I)
8	Number of Comment records - if zero, none. (I)
9	Number of Gain/Offset records (36)
10	Number of Linear conversion factor records (10)
11	Number of L value records (3)

COMMENT RECORDS (all records CHAR*80):

Rec.

1-N	Comment records

GAIN/OFFSET RECORDS (all words REAL):

Rec.	Description
1	G(low) for V1
2	O(low) for V1
3	G(hi) for V1
4	O(hi) for V1
5	G(low) for V2
6	O(low) for V2
7	G(hi) for V2
8	O(hi) for V2
9	G(low) for V3
10	O(low) for V3
11	G(hi) for V3
12	O(hi) for V3
13	G(low) for V4
14	O(low) for V4
15	G(hi) for V4

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16	O(hi) for V4
17	G(low) for V12
18	O(low) for V12
19	G(hi) for V12
20	O(hi) for V12
21	G(low) for V34
22	O(low) for V34
23	G(hi) for V34
24	O(hi) for V34
25	G(low) for F1
26	O(low) for F1
27	G(hi) for F1
28	O(hi) for F1
29	G(low) for F2
30	O(low) for F2
31	G(hi) for F2
32	O(hi) for F2
33	G(low) for F3
34	O(low) for F3
35	G(hi) for F3
36	O(hi) for F3

LINEAR CONVERSiON FACTOR RECORDS (all words REAL):

Rec.	Description
1	a (slope) for conversion of F1 to uV/m/SQRT(Hz)
2	b (int.) for conversion of F1 to Uv/M/SQRT(Hz)
3	a (slope) for conversion of F2 to uV/m/SQRT(Hz)
4	b (int.) for conversion of F2 to Uv/M/SQRT(Hz)
5	a (slope) for conversion of F3 to uV/m/SQRT(Hz)
6	b (int.) for conversion of F3 to Uv/M/SQRT(Hz)
7	a (slope) for conversion of V1 and V2 to vehicle pot.
8	b (int.) for conversion of V1 and V2 to vehicle pot.
9	a (slope) for conversion of V3 and V4 to vehicle pot.
10	b (int.) for conversion of V3 and V4 to vehicle pot.

L VALUE RECORDS (ALL WORDS real):

Rec.	Description
1	L1
2	L2
3	L3

16.0 ONR 307-3-1,-2,-3 SPECTROMETER FOR ELECTRONS AND PROTONS (SEP)

PRINCIPAL INVESTIGATOR: Richard Vondrak / LPARL
Jack Quinn / LPARL
Richard Nightingale / LPARL
Hank Voss / LPARL
Robert Robertson / LPARL

16.1 THDB DERIVABLE PARAMETERS

The ONR 307-3 package consists of three sensors mounted at 80, 60, and 40 degrees to the spacecraft spin axis.

Each of the sensors:

1.   is independently commandable.

2.   is capable of making electron measurements between 20-5000keV, or proton measurements between 0.5·100 MeV; actual energy ranges selected in both electron and proton mode are commandable.

3.   provides 12 point differential flux spectra along with four integral flux measurements.

Typical modes that are being used during the CRRES mission are shown below:

SPECIES	MODE	ENERGY RANGE	CHANNEL WIDTH
ELECTRONS	ELEC1	20-300 keV	20 keV
	ELEC2	300-5000 keV	400 keV
PROTONS	PROT1	0.5-4.5 MeV	330 keV
	PROT2	4.5-20 MeV	1.25 MeV
	PROT3	20-45 MeV	2.0 MeV
	PROT4	45-100MeV	4.2 MeV

Each of the 3 spectrometers is uplink commandable and is capable of providing electron spectra (20-5000eV) or proton spectra (0.5- 100MeV) measurements as 12 point differential flux spectra and 4 point integral flux readouts. The sensors at 80 and 60 degrees provide a full set of spectra every 0.256 s; the sensor at 40 degrees produces the 12 spectra points and 4 integral flux values every 0.512 seconds. The spectra and integral flux data along with the status word information for all sensors will be included in the THDB at the full data rate.

16.2 THDB DATA RECORD STRUCTURE

The THDB files for this data will consist of a header record followed by a series of data records. The header record is in 32 bit positive integer form. There will be one data record every 2 masterframes (8.192 seconds). Data values are in compressed counts.

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HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (3073)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-330	Vacant (Zero fill)

DATA RECORDS:

Word Number	Description
1	UT (milliseconds) at start of minor frame associated with the first SEPA spectra (minor frame 2)
2	Bytes 1-4: First 4 SEPA status words for this masterframe
3	Bytes 1-2: Last 2 SEPA status words for this masterframe Bytes 3-4: Vacant
4	Vacant
5-7	First SEPA spectra for this 4.096 second interval (data stored in consecutive bytes)
8-10	2nd SEPA spectra for this 4.096 second interval (data stored in consecutive bytes)
.	. . . .
50-52	16th SEPA spectra for this 4.096 second interval (data stored in consecutive bytes)
53-56	16 values of integral flux values 'DA' for this 4.096 second interval stored in byte form.
57-60	16 values of integral flux values 'EA' for this 4.096 second interval stored in byte form.
61-62	8 values of integral flux values 'AA' for this 4.096 second interval stored in byte form.
63-64	8 values of integral flux values 'EPA' for this 4.096 second interval stored in byte form.
65-128	Repeat order of words 1-64 for the next 4.096 second interval containing the SEPA data
129-256	Repeat the order of words 1-128 for the 8.192 second interval for the SEPB data. With respect to the integral flux values, the DA, EA, AA, EPA values are replaced by DB, EB, AB, and EPB, respectively.
257	UT (milliseconds) at start of minor frame associated with the first SEPC spectra (minor frame 4)
258	Bytes 1-4: First 4 SEPC status words for this masterframe
259	Bytes 1-2: Last 2 SEPC status words for this masterframe Bytes 3-4: Vacant
260	Vacant
261-263	First SEPC spectra for this 8.192 second interval (data stored in consecutive bytes)
264-266	2nd SEPA spectra for this 8.192 second interval (data stored in consecutive bytes)

. . . .
. . . .
. . . .

306-308	16th SEPC spectra for this 8.192 second interval (data stored in consecutive bytes)
309-312	16 values of integral flux values 'DC' for this 8.192 second interval stored in byte form.
313-316	16 values of integral flux values 'EC' for this 8.192 second interval stored in byte form.
317-320	16 values of integral flux values 'AC' for this 8.192 second interval stored in byte form.
321-324	16 values of integral flux values 'EPC' for this 8.192 second interval stored in byte form.
325	Byte 1: Telemetry mode flag associated with the first of the 4.096 second intervals (0 = GTO; 1 = LASSII).
	Byte 2: Telemetry mode flag associated with the second 4.096 second interval.
	Byte 3: Telemetry dropout flag associated with the first of the 4.096 second time intervals (0 = No dropout in the interval; 1 = dropout somewhere in the time interval)
	Byte 4: Telemetry dropout flag associated with the second of the 4.096 second time intervals (0 = No dropout in the interval; 1 = dropout somewhere in the time interval)
326-330	Vacant

Notes:

1. Data obtained during LASSII telemetry mode will be stored in the THDB but may be unusable. For the LASSII periods, the LASSII flag will be set to 'on' in the THDB.

2. The word order of the spectra is as it is extracted from the telemetry stream and has not been reordered to be monotonic with respect to energy. The channel order is thus, 2, 4, 6, 8, 10, 12, 1, 3, 5, 7, 9, and 11.

3 The THDB user must determine the instrument mode from the status bits (bit numbering is 7 for the MSB and bit 0 for the LSB):

   a. If the Amplifier Gain (LSB of the 3rd status word) bit is 1, the data is electrons. If the bit is 0, the data is protons or Alpha particles. To determine whether data is protons or Alphas, if the D Logic bit (bit 4 of the 3rd status word) is 1 (for coincidence) AND the PHA lower threshold (status word 5 of the 6 status words) is GREATER than 60 decimal then the data is Alphas.

   b. The current operating page number can be obtained form the 3 LSBs of the first of the six status words.

   c. The current operating mode number within the current page may be obtained from the 3 MSBs of the second of the 6 status words.

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d.   The PHA lower energy threshold can be obtained from the full 8 bit readout of the fourth of the 6 status words. Calibration data will be required to convert this value to energy.

e.   The PHA upper energy threshold can be obtained from 6 MSBs of the fifth of the six status words. Calibration data will be required to convert this value to energy.

16.3 CALIBRATION FILE RECORD STRUCTURE

The ONR 307-3 calibration file structure is TBD.

17.0 ONR 307-8-1/-2 LOW ENERGY ION MASS SPECTROMETER (IMS-LO-1, IMSLO-2)
PRINCIPAL INVESTIGATOR: Richard Vondrak / LPARL
Jack Quinn / LPARL
Richard Nightingale / LPARL
Hank Voss / LPARL
Robert Robertson / LPARL

17.1 THDB DERIVABLE PARAMETERS

The THDB file for the two IMS-LO sensors consists of a pre-processed file. The file contains all the data for telemetry designation S39 (IMS-LO-1) as well as telemetry designation S40 (IMS-LO-2). In addition, the file contains telemetry dropout flags and LASSII telemetry mode flags.

The time tag associated with each masterframe block is the time at the start of the masterframe on which the data was readout to telemetry. Due to a double buffer system, the data was accumulated during the previous 8.192 second interval.

The 8 subcommutated values of S39 (and S40) represent the instrument status words. The minor frame values of S39 (and S40) represent the spectra data. The first of the seven words on each minor frame contains the electron spectra data and the remaining 6 words contain the ion mass spectrometer data.

Depending on the mode, various parameters are available:

SWEEP MODE. For a fixed energy, a 32 point mass spectrum is obtained. There are 48 energies which are stepped though. The mode duration is 32.768 s. Mass range is 1 to 32 AMU's. An 8 point electron spectra is also produced.

LOCK MODE. For a fixed mass, a 45 point differential flux spectrum and 3 background readouts are obtained. Four masses are selected by ground command and they are sequentially stepped through. Each selected mass is held for 32.768 s. One full spectra is obtained every 1.024 s. Energy range is 0.1-32keV. Eight point electron spectra are produced along with the ion spectra.

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SWEEP-LOCK mode. Alternates between SWEEP and LOCK modes every 32.768 seconds (8 major frames).

HIGH MASS RANGE mode. Multiplies mass range by a factor of 16 (oxygen to barium). This can be used in conjunction with SWEEP, LOCK and SWEEP-LOCK modes.

ELECTRON SPECTRA: Four point electron spectra are obtained for each of the IMS-LO sensors. These may be combined from the 2 sensors to produce an 8 point spectrum. The energy range for the 8 point spectrum is approximately 67eV - 20keV. These spectra are produced independent of IMS-LO operating mode.

17.2 THDB DATA RECORD STRUCTURE

The THDB files for this data will consist of a header record followed by a series of data records. The header record is in 32 bit positive integer form. There will be one data record every 8 major frames (32.768 sec). The data records contain the full set of telemetry designation S39 (IMS-LO-1) and S40 (IMS-LO-2) data along with telemetry dropout and LASSII telemetry mode flags.

HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (307812)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-910	Vacant (Zero fill)

DATA RECORDS:

Word Number	Description	
1	UT (milliseconds) at start of first masterframe	
2	Byte 1(MS byte):	S39 from minor frame 0
	Byte 2	S39 from minor frame 0
	Byte 3	S39 from minor frame 0
	Byte 4	S39 from minor frame 0
3	Byte 1(MS byte):	S39 from minor frame 0
	Byte 2	S39 from minor frame 0
	Byte 3	S39 from minor frame 0
	Byte 4	S39 from minor frame 1
4	Byte 1(MS byte):	S39 from minor frame 1
	Byte 2	S39 from minor frame 1
	Byte 3	S39 from minor frame 1
	Byte 4	S39 from minor frame 1

. . . .
. . . .
. . . .

57	Byte 1(MS byte):	S39 from minor frame 31
	Byte 2	S39 from minor frame 31
	Byte 3	S39 from minor frame 31
	Byte 4	S39 from minor frame 31
58	Byte 1(MS byte):	S40from minor frame 0
	Byte 2	S40from minor frame 0
	Byte 3	S40from minor frame 0
	Byte 4	S40from minor frame 0
59	Byte 1(MS byte):	S40from minor frame 0
	Byte 2	S40from minor frame 0
	Byte 3	S40from minor frame 0
	Byte 4	S40from minor frame 1
60	Byte 1(MS byte):	S40from minor frame 1
	Byte 2	S40from minor frame 1
	Byte 3	S40from minor frame 1
	Byte 4	S40from minor frame 1
.	.	. .
.	.	. .
.	.	. .
113	Byte 1(MS byte):	S40from minor frame 31
	Byte 2	S40from minor frame 31
	Byte 3	S40from minor frame 31
	Byte 4	S40from minor frame 31
114	UT (milliseconds) at start of 2nd masterframe	
115	Byte 1(MS byte):	S39 from minor frame 0
	Byte 2	S39 from minor frame 0
	Byte 3	S39 from minor frame 0
	Byte 4	S39 from minor frame 0
116	Byte 1(MS byte):	S39 from minor frame 0
	Byte 2	S39 from minor frame 0
	Byte 3	S39 from minor frame 0
	Byte 4	S39 from minor frame 1
117	Byte 1(MS byte):	S39 from minor frame 1
	Byte 2	S39 from minor frame 1
	Byte 3	S39 from minor frame 1
	Byte 4	S39 from minor frame 1
.	.	. .
.	.	. .
.	.	. .
169	Byte 1(MS byte):	S39 from minor frame 31
	Byte 2	S39 from minor frame 31
	Byte 3	S39 from minor frame 31
	Byte 4	S39 from minor frame 31
170	Byte 1(MS byte):	S40from minor frame 0
	Byte 2	S40from minor frame 0
	Byte 3	S40from minor frame 0
	Byte 4	S40from minor frame 0

171	Byte 1(MS byte):	S40from minor frame 0
	Byte 2	S40from minor frame 0
	Byte 3	S40from minor frame 0
	Byte 4	S40from minor frame 1
172	Byte 1(MS byte):	S40from minor frame 1
	Byte 2	S40from minor frame 1
	Byte 3	S40from minor frame 1
	Byte 4	S40from minor frame 1
.	.	. .
.	.	. .
.	.	. .
226	Byte 1(MS byte):	S40from minor frame 31
	Byte 2	S40from minor frame 31
	Byte 3	S40from minor frame 31
	Byte 4	S40from minor frame 31
227-339	Repeat order of words 1-113 for 3rd masterframe	
340-452	Repeat order of words 1-113 for 4th masterframe	
453-565	Repeat order of words 1-113 for 5th masterframe	
566-678	Repeat order of words 1-113 for 6th masterframe	
679-791	Repeat order of words 1-113 for 7th masterframe	
792-904	Repeat order of words 1-113 for 8th masterframe	
905	Byte 1:(MS byte) S39 subcom from masterframe 1	
	Byte 2:S39 subcom from masterframe 2	
	Byte 3:S39 subcom from masterframe 3	
	Byte 4:S39 subcom from masterframe 4	
906	Byte 1:(MS byte) S39 subcom from masterframe 5	
	Byte 2:S39 subcom from masterframe 6	
	Byte 3:S39 subcom from masterframe 7	
	Byte 4:S39 subcom from masterframe	
907	Byte 1:(MS byte) S40 subcom from masterframe 1	
	Byte 2:S40 subcom from masterframe 2	
	Byte 3:S40 subcom from masterframe 3	
	Byte 4:S40 subcom from masterframe 4	
908	Byte 1:(MS byte) S40 subcom from masterframe 5	
	Byte 2:S40 subcom from masterframe 6	
	Byte 3:S40 subcom from masterframe 7	
	Byte 4:S40 subcom from masterframe 8	
909	Byte 1:Telemetry dropout flags for the 8 masterframes (bit 7 (msb) for first masterframe; bit 0 for 8th masterframe) where a 0 bit indicates no dropout within the masterframe and a 1 bit indicates dropout somewhere within the masterframe.	
	Byte 2:LASSII flag (where a value of 1 in this byte indicates LASSII telemetry mode has been detected and the data in this group of 8 masterframes is most likely invalid and that a data gap follows)	
	Bytes 3 and 4 are vacant (zero fill)	
910	Vacant (zero fill)	

17.3 CALIBRATION FILE RECORD STRUCTURE

The ONR 307-8-1/-2 calibration file record structure is TDB.

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18.0 ONR 307-8-3 MEDIUM ENERGY ION MASS SPECTROMETER (IMS-HI)

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                           Jack Quinn / LPARL
                           Richard Nightingale/
                               LPARL
                           Hank Voss / LPARL
                           Robert Robertson /
                               LPARL

18.1 PARAMETER LIST

The THDB file for this sensor consists of a pre-processed file containing all minor frame and subcommutated words necessary for analysis of the data. Each record contains data accumulated over 8 masterframes. The subcommutated data reflecting the instrument mode appears two masterframes (8.192 seconds) before the accumulated science data is readout. The THDB routine will align the status information with the science data output to facilitate input to follow-on analysis routines.

The information below reflects the information which can be derived from the THDB by follow-on analysis routines.

MODES/PARAMETERS

i)   Mass Lock Mode - For 4 fixed (commandable) masses, 6 point differential flux ion spectra and a neutral read out are obtained. The energy range of the spectra varies with mass, e.g. H+ is approximately 30 keV to 2.5 MeV; He+ is approximately 7 keV to 1 MeV. Time duration for these spectra is 0.512 seconds.

ii)   Mass Scan Mode - 64 point mass spectra has 7 energies. Time duration is 8.192 seconds.

iii)   Sweep-Lock (mass scan - mass lock) - alternates between scan and lock every 8 major frames (32.768 seconds).

iv)   The two singles counters associated with each of the 7 detector elements.

v)   The subcommutated data.

vi)   Data flag to indicate that a telemetry mode switch from GTO to LASSII is forthcoming.

18.2 THDB DATA RECORD STRUCTURE

The THDB files for this data will consist of a header record followed by a series of data records. The header record is in 32 bit positive integer form. There will be one data record every 8 masterframes (32.768 seconds). The status information contained on the subcommutator precedes the science data by two masterframes within the telemetry stream. In the THDB generation, the status information has been realigned with the science output.

HEADER RECORD (All words 32 bit integers)

Word Number	Description
	Description
1	Experiment ID (30783)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-604	Vacant (Zero fill)

DATA RECORDS:

Word Number		Description
1		UT (milliseconds) at start of first masterframe
2	Byte 1:	Subcom 17 subframe 17
	Byte 2:	Subcom 17 subframe 18
	Byte 3:	Subcom 17 subframe 19
	Byte 4:	Subcom 17 subframe 20
3	Byte 1:	Subcom 17 subframe 21
	Byte 2:	Subcom 17 subframe 22
	Byte 3:	Subcom 17 subframe 23
	Byte 4:	Subcom 17 subframe 24
4	Bytes 1-4:	Minor frame words 19, 53, 83, 115 from MF0
5	Bytes 1-4:	Minor frame words 147, 179, 211, 237 from MF0
6	Byte 1:	Minor frame word 243 from MF0
	Bytes 2-4:	Minor frame words 19, 53, 83 from MF1
7	Bytes 1-4:	Minor frame words 115, 147, 179, 211 from MF1
.	.	.
.	.	.
.	.	.
75	Bytes 1-4:	Minor frame words 179, 211, 237, 243 from MF 31.
76-150		Repeat order of words 1-75 for 2nd masterframe 151-225
151-225		Repeat order of words 1-75 for 3rd masterframe
.	.	.
.	.	.
.	.	.
526-600		Repeat order of words 1-75 for 8th masterframe
601		Telemetry mode flags (0 = GTO, 1= LASSII):
	Byte 1:	Telemetry mode flag for 1st masterframe
	Byte 2:	. . 2nd .
	Byte 3:	. . 3rd .
	Byte 4:	. . 4th .
602	Bytes 1-4:	Telemetry mode flags associated with masterframes 5-8

603	Telemetry dropout flags (0 = no dropout, 1 = dropout)	
	Byte 1:	Telemetry dropout flag associated with 1st masterframe
	Byte 2:	Telemetry dropout flag associated with 2nd masterframe
	Byte 3:	Telemetry dropout flag associated with 3rd masterframe
	Byte 4:	Telemetry dropout flag associated with 4th masterframe
604	Bytes 1-4:	Telemetry dropout flags associated with masterframes 5-8.

Note:

1. The realignment of the status information with the science data has been accomplished as follows:

   Since there are 8 masterframes per record on the Agency file, the status (subcommutated words) from masterframe 1 are selected and associated with masterframe 3 of the 8 masterframes. This process continues through the 32 second interval. Thus, while the status data is taken from masterframes 1 through 8 on an Agency Tape record, the minor frame data for the 32 second interval is taken from masterframe 3 of record N through record 2 of record N+1. The time tags for the masterframe data are those associated with masterframes 3 of record N through masterframe 2 of record N+1. This procedure will cause the data contained in the first two masterframes of an orbit to be lost; but the instrument status for this data is unknown anyway.

18.3 CALIBRATION FILE RECORD STRUCTURE

The ONR 307-8-3 calibration file structure is TBD.

19.0 ONR 604 ISOTOPES AND SOLAR FLARES

PRINCIPAL INVESTIGATOR: Dr. John Simpson /
University of Chicago

Dr. Moises Munoz /
University of Chicago

Dr. John Wefel / LSU

19.1 THDB DERIVABLE PARAMETERS

The prime ONR 604 THDB parameters are the count rates from the P1, P2, and P3 channels as well as singles rate data which occur once per masterframe. P3 measures primarily protons from 40 to approximately 600 MeV/nucleon. For P3, the proton component is present only when the instrument is in proton mode. P2 represents the count rate for helium through neon in the energy range from approximately 45-200 MeV/nucleon. Most of the P2 count rate is helium. P1 represents the count rate for neon through iron in the energy range greater than 100 MeV/nucleon. There are 16 singles rates one of which is readout every masterframe. It thus takes 16 masterframes to get the full set of single data. The subcom ID is included in the THDB since it is needed to determine which singles value is present in a given 4.096 second period.

Data flags are included to indicate instrument mode (proton mode or heavy ion mode); when an in-flight calibration is in progress; whether telemetry dropout was present in the masterframe; and to note that a data gap will be present due to a switch to LASSII telemetry mode. Instrument analogs and discretes are also be stored in the THDB. Additional parameters are included in the THDB, but these parameters are for in-house use at PL in support of the MEP.

Each THDB record consists of data accumulated over a masterframe (4.096 seconds).

19.2 THDB RECORD STRUCTURE

The ONR 604 THDB files consist of a header record followed by a series of data records for each orbit. There is one record per masterframe (4.096 seconds).

HEADER RECORD (All words 32 bit integers)

Word Number	Description
1	Experiment ID (604)
2	Year
3	Day of Year
4	Orbit Number
5	Start Time of orbit (UT in milliseconds)
6	End Time of orbit (UT in milliseconds)
7-106	Vacant (Zero fill)

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DATA RECORDS:

Word Number	Description
1	UT (milliseconds at the start of the masterframe
2	P1 decompressed counts
3	P2 decompressed counts
4	P3 decompressed counts
5	Singles rate (decompressed counts)
6	Subcom number
7	Byte 1:Proton CMD flag (0 = heavy ion mode; 1 = proton mode)
	Byte 2:Calibration mode flag (0 = no calibration; 1 = calibration in progress)
	Byte 3:Telemetry mode flag (0 = normal; 1 = data gap follows due to a switch from GTO or CSM telemetry modes to LASSII mode)
	Byte 4:Telemetry dropout indicator (0 = no dropout in this masterframe; 1 = some words are 1's filled due to telemetry dropout).
8	Byte 1:A293
	Byte 2:A294
	Byte 3:B33
	Byte 4:Bit 2 = P1 flag, bit 1 = P2 flag, bit 0 = P3 flag
9-11	Telemetry words 25, 57, 89, 121, 153, 156, 185, 188, 217, 220, 249, 252 (stored in successive bytes) from minor frame 0.
12-14	Telemetry words 25, 57, 89, 121, 153, 156, 185, 188, 217, 220, 249, 252 (stored in successive bytes) from minor frame 1.
102-104	Telemetry words 25, 57, 89, 121, 153, 156, 185, 188, 217, 220, 249, 252 (stored in successive bytes) from minor frame 31.
105-106	Vacant

Note: Since one singles readout is obtained every masterframe, the full set of singles readouts requires 16 masterframes (65.536 seconds). The information in the "singles rates" is a function of the subcom number. The table below relates the "singles rates" outputs to the subcom number.

Subcom Number	Singles Readout
0	D1
1	D2
2	D3
3	D4
4	D5
5	D6
6	K1
7	K2
8	K3
9	K4
10	K5
11	K6

```
12              K7
13              K8
14              A
15              S
```

19.3 CALIBRATION FILE

The format of the ONR-604 calibration file is TBD.

20.0 EPHEMERIS DATA

Spacecraft vectors are received at PL from the Consolidated Satellite Test Center (CSTC). These vectors along with magnetic field models are used as the prime input to the ephemeris generation routines. These routines are run prior to the Agency Tape generation process.

20.1 THDB DATA BASE DERIVABLE PARAMETERS

Ephemeris data files are replicas of those placed on the Agency Tapes. Data records are in 32 bit positive integer form (31 data bits and the MSB set equal to 0). Offset and bias values are provided to convert the positive integer values to true units. For altitudes less than 3 Earth Radii, the data rate is once per minute. For higher altitudes, the rate is once per 5 minutes.

To convert the 32 bit positive integer data to proper units (e.g. km), subtract $2**30$ from the value and then multiply by the appropriate factor. All factors are in powers of 10.

20.2 THDB DATA BASE FORMAT

The table below gives the appropriate multiplicative factor for each word on the ephemeris file (e.g. if power is 2, then multiply the integer word by $10**2$ after subtracting $2**30$).

Word Number	Description	Factor
1	Julian Date (days)	0
2	UT (milliseconds)	0
3	X, Satellite Position, ECI (km)	-4
4	Y, Satellite Position, ECI (km)	-4
5	Z, Satellite Position, ECI (km)	-4
6	VX, Satellite Velocity, ECI (km/sec)	-7
7	VY, Satellite Velocity, ECI (km/sec)	-7
8	VZ, Satellite Velocity, ECI (km/sec)	-7
9	Radius, Earth Center To Satellite (km)	-4
10	Altitude (km)	-4
11	Latitude (deg)	-6
12	Longitude (deg)	-6
13	Velocity (km/sec)	-7
14	Local Time (hr)	-7
15	Radius, MAG (EMR)	-7

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16	Latitude, MAG (deg)	-6
17	Longitude, MAG (deg)	-6
18	Radius, SM (EMR)	-7
19	Latitude, SM (deg)	-6
20	Local Time, SM (hr)	-7
21	Radius, GSM (EMR)	-7
22	Latitude, GSM (deg)	-6
23	Local Time, GSM (hr)	-7
24	B, (nT)	-4
25	BX, ECI (nT)	-4
26	BY, ECI (nT)	-4
27	BZ, ECI (nT)	-4
28	Magnetic Local Time (hr)	-7
29	Solar Zenith Angle (deg)	-6
30	Invariant Latitude (deg)	-6
31	B100N Latitude (deg)	-6
32	B100N Longitude (deg)	-6
33	B100S Latitude (deg)	-6
34	B100S Longitude (deg)	-6
35	L-Shell (EMR)	-7
36	BMIN (nT)	-4
37	BMIN Latitude (deg)	-6
38	BMIN Longitude (deg)	-6
39	BMIN Alt (km)	-4
40	BCONJ Latitude (deg)	-6
41	BCONJ Longitude (deg)	-6
42	BCONJ Alt (km)	-4
43	X Sun Position-ECI (km)	0
44	Y Sun Position-ECI (km)	0
45	Z Sun Position-ECI (km)	0
46	X Moon Position- ECI (km)	0
47	Y Moon Position-ECI (km)	0
48	Z MOON Position-ECI (km)	0
49	Right Ascension of Greenwich	-6
50	B100N Magnetic Field (nT)	-4
51	B100S Magnetic Field (nT)	-4
52	Mx Dipole Moment-ECI (nT)	-4
53	My Dipole Moment-ECI (nT)	-4
54	Mz Dipole Moment-ECI (nT)	-4
55	Dx Dipole Offset-ECI (km)	-4
56	Dy Dipole Offset-ECI (km)	-4
57	Dz Dipole Offset-ECI (km)	-4
58-60	Vacant	

Notes:

1. MAG - Magnetic Coordinates; The Z axis is parallel to the dipole, and the south geographic pole is in the +X,Z Plane.

2. SM - Solar Magnetic Coordinates; The Z axis is parallel to the dipole, and the sun is in the +X,Z Plane.

3. GSM - Geocentric Solar Magnetospheric Coordinates; The X axis is
    parallel to the earth - sun line and the earth's dipole is in the X,+Z plane.

4. EMR = 6371.2 km

5. The equatorial radius is defined as 6378.135 km, and the flattening is
    298.26.

21.0 ATTITUDE DETERMINATION DATA

The attitude determination fit coefficients are generated as part of the Agency Tape
generation process. The routines which produce the coefficients use spacecraft sun sensor,
horizon sensor and magnetometer data as their prime inputs. The attitude coefficient file is
identical to the attitude coefficient file stored on the Agency Tapes.

21.1 ATTITUDE COEFFICIENT FILE

This file contains the output of the attitude determination program. Data records are in
ASCII. The data consists of a series of time tagged coefficients from fits of attitude
motion. This file is used in conjunction with software (program AGMOD) provided to the
agencies to calculate sensor LOS as a function of time. The file structure consists of a
header information followed by the fit coefficient data.

21.2 ATTITUDE COEFFICIENT FILE FORMAT

21.2.1 HEADER INFORMATION

Record Number	Description	Word Type
1	File Name	Alpha
2	Vehicle ID	Alpha
3	GTO (LAS) Period Number	Alpha
4	Year	Integer
5	Day of Year	Integer
6	UT at start of data (ms)	Integer
7	UT at end of data (ms)	Integer
8	Number of fit spans	Integer

21.2.2 FIT COEFFICIENT RECORDS

Record Number	Description	Word Type
1	Index (State Vector) Number	Integer
2	Segment Start Time (sec)	Floating
3	Segment End Time (sec)	Floating
4	Time Conversion Scale Factor	Floating
5	Time Conversion Offset Factor	Floating
6	Condition Flag Number	Integer
7	Order of RA Fit Coef (N1)	Integer
8	Spin Axis RA Fit Coefficient 1	Floating

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9	Spin Axis RA Fit Coefficient 2	Floating
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.	Spin Axis RA Fit Coefficient N1	Floating
	Order of DEC. Fit Coefficient (N2)	Integer
	Spin Axis DEC. Coef. 1	Floating
.	Spin Axis DEC. Coef. 2	Floating
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.	.	.
.	Spin Axis DEC. Coef. N2	Floating
.	Order of Spin Rate Fit Coef. (N3)	Integer
.	Spin Rate Coef. 1	Floating
.	Spin Rate Coef. 2	Floating
.		
.	.	.
.	Spin Rate Coef. N3	Floating
.	Spin Phase at Start of Segment	Floating